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The Feasibility of Using Color Aerial Photography to Detect and Evaluate Sulphur Dioxide Injury to Timber Stands

by

Kristina A. Zealear, Robert C. Heller, Nancy X. Norick, Marilyn Wilkes

Pacific Southwest Forest and Range Experiment Station
Berkeley, California

November 1971

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A feasibility study was undertaken in Alabama near a point source of sulphur dioxide, SO_2 emissions to determine the best film-filter-scale combination of aerial photography to evaluate SO_2 injury to forest vegetation. Normal color film, exposed through a didymium filter, at very large scales (1:800 and 1:1,584) proved to be the most accurate sensor. Color infrared film was almost as good. Interpreter differences were least at large scale and on color film. Ground variables which were best correlated with photo interpretation were: crown color, needle color, Munsell hue, percent of current needles with tip dieback and the length of the tip dieback. Because fumigation effects are cumulative, total injury impact on the resource will have to be measured over a 5- to 6-year period of time. A combination of photo and ground plots appears to be the most efficient design for measuring these effects--especially if done over large areas.

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ABSTRACT

A feasibility study was undertaken in Alabama near a point source of sulphur dioxide (SO_2) emissions to determine the best film-filter-scale combination of aerial photography to evaluate SO_2 injury to forest vegetation. Normal color film, exposed through a didymium filter, at very large scales (1:800 and 1:1,584) proved to be the most accurate sensor. Color infrared film was almost as good. Interpreter differences were least at large scale and on color film. Ground variables which were best correlated with photo interpretation were: crown color, needle color, Munsell hue, percent of current needles with tip dieback and the length of the tip dieback. Because fumigation effects are cumulative, total injury impact on the resource will have to be measured over a 5- to 6-year period of time. A combination of photo and ground plots appears to be the most efficient design for measuring these effects--especially if done over large areas.

Details of illustrations in this document may be better studied on microfiche

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Kristina A. Zealear, Robert C. Heller, Nancy X. Norick, Marilyn Wilkes[1]

Pacific Southwest Forest and Range Experiment Station
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INTRODUCTION

The major part of the electric power produced in the Tennessee Valley is supplied by coal-fired steam plants. The combustion of coal releases large amounts of gases into the atmosphere, including sulphur dioxide (SO_2). Under certain meteorological regimes poor atmospheric dispersion conditions may cause the smoke plume to be carried to the ground, resulting in a fumigation. During a fumigation sensitive vegetation may be injured by phytotoxicants, particularly SO_2, in plume.

The Tennessee Valley Authority has conducted extensive ground surveys near its Widows Creek Steam Plant to determine the extent and severity of SO_2 injury to vegetation. But, because of the widespread area that the plant's smoke plume can reach, a more efficient survey method is desirable.

In 1969, the remote sensing research unit at the Pacific Southwest Forest and Range Experiment Station was asked to evaluate the usefulness of color aerial photography for detection and estimation of SO_2 damage to trees in the Tennessee Valley. This feasibility study was conducted in cooperation with the TVA and the U. S. Department of Health, Education, and Welfare. The objectives of the study were to find the best film, filter, and scale combination for detection of SO_2 injury and to develop an efficient technique for future surveys. The study consisted of four stages:

1. Establishment of study plots on the ground and collection of data on the effects of SO_2 to individual trees.

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[1] Geographer, research forester, mathematical statistician, and mathematician, respectively, Pacific Southwest Forest and Range Experiment Station, Forest Service, USDA, Berkeley,, California.

2. Aerial photography of plots at several film and scale combinations.

3. Photo interpretation of vegetation injury from SO_2 emissions.

4. Comparison of ground and photo interpretation data and analyses.

To date, two surveys--in June 1969 and in August 1970--have been completed. This report describes the procedures used and summarizes results obtained. It offers some conclusions that may be drawn and suggests some improvements that could be made.

STUDY AREA

The TVA's Widows Creek Steam Plant is located in Alabama and is sited on the bank of the Tennessee River in a 5-mile-wide valley between the Cumberland Plateau to the north and Sand Mountain to the south. Both the plateau and Sand Mountain rise to an elevation of 1,000 feet above the valley floor. Under certain meteorological conditions, winds tend to carry smoke from the plant's stacks south and east toward the mountain, resulting in a relatively high frequency of SO_2 fumigations (Fig. 1). The effects of sulphur dioxide emissions on vegetation have been observed on Sand Mountain since 1966 in an area extending from 1.7 to 5 miles southeast of the plant. Our studies were concentrated in that area.

METHODS

GROUND PROCEDURES

Study Plot Establishment

Personnel from the TVA were responsible for all ground work for the feasibility test, including choosing the study sites. On Sand Mountain they established sampling points consisting of paired study plots. Control plots were set up 40 miles away on Lookout Mountain where no effects of sulphur dioxide pollution have been observed (Fig. 2).

Sampling points were established in three major timber types--planted loblolly pine, natural pine-hardwood and natural pine stands (Fig. 3). As closely as possible, the control plots matched the affected plots in species composition, stand density, topography, aspect, and other site conditions.

In 1969, we surveyed seven pairs of plots at seven sampling points--four in the affected area (plots 1, 2, 3, & 4) and three in the control area (plots 11, 12, & 13). In 1970, the same seven pairs of plots were resurveyed and, in addition, we surveyed one more pair (plot 14) in an area which had been severely affected in 1969 (Table 1).

At each sampling point, field crews established a pair of rectangular one-fifth-acre plots. Each plot measured one chain (66 feet or 20.2 m) by

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Figure 1. Widows Creek Steam Plant by the Tennessee River in Alabama. Newest smoke stacks are 500 feet tall.

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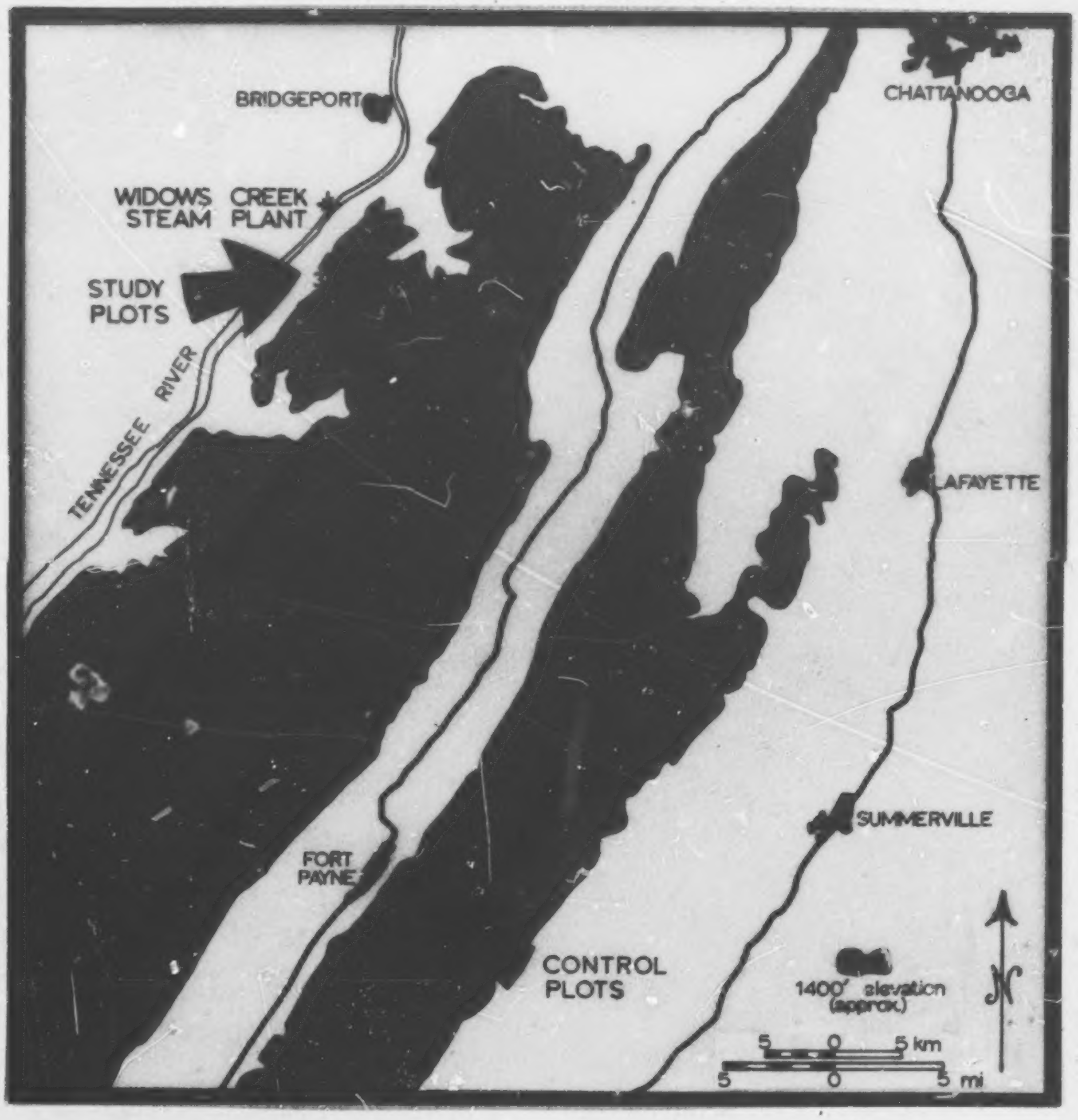
BRIDGEPORT
WIDOWS CREEK STEAM PLANT
STUDY PLOTS
TENNESSEE RIVER
CHATTANOOGA
LAFAYETTE
SUMMERVILLE
FORT PAYNE
CONTROL PLOTS
1400' elevation (approx.)
5 0 5 km
5 0 5 mi
N

Figure 2. Location of Widows Creek Steam Plant in relation to remote sensing study plots (sampling points).

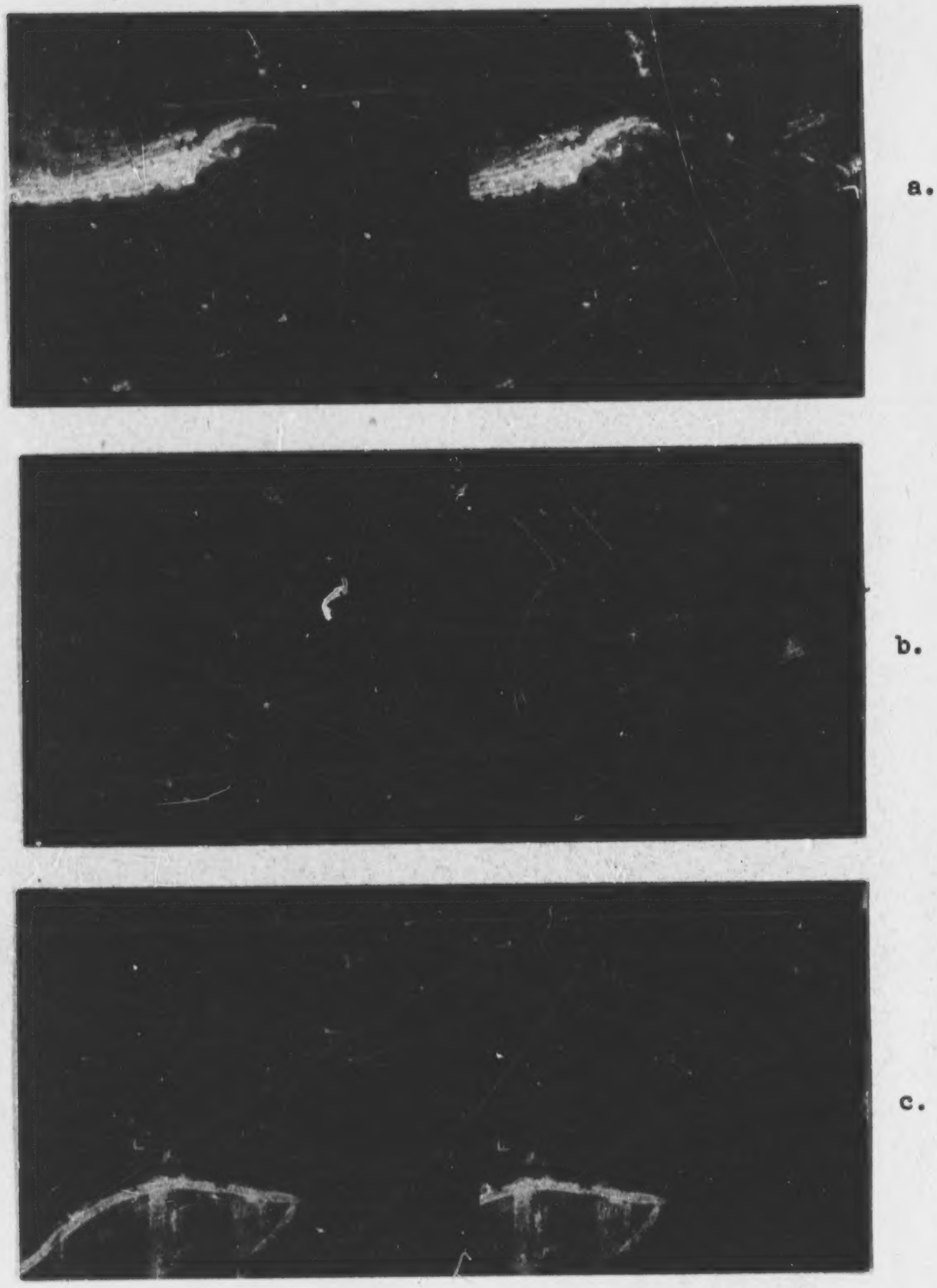

Figure 3. Three different timber types included in the SO_2 injury study:

a. Loblolly pine plantation (plot 11)

b. Natural pine-hardwood stand (plot 4)

c. Natural pine stand (plot 12)

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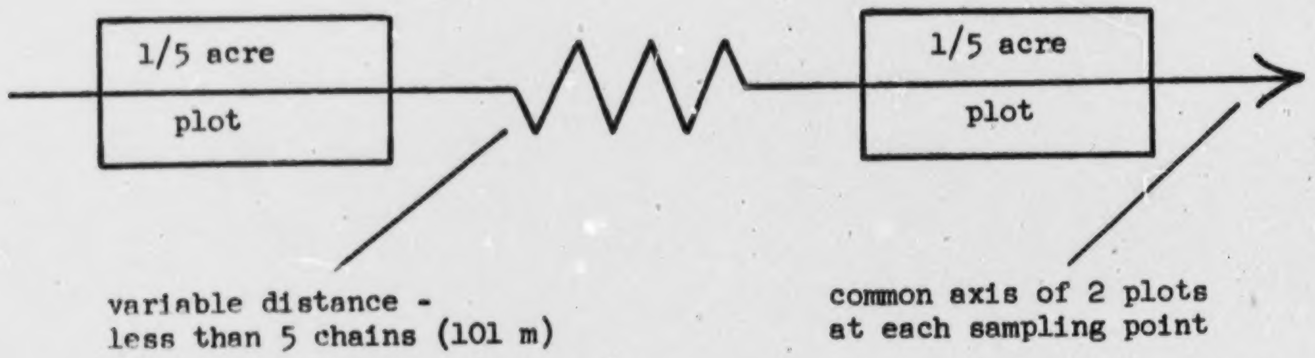
Table 1. Stand characteristics of each sampling point (plot pair) photographed for the SO_2 injury study. (Figure 2 shows location of each sampling point.)

Area	Plot No.	Stand description
Sand Mountain (Affected)	1	Loblolly pine plantation, 2 to 6 inch d.b.h.
	2	Loblolly pine plantation, 4 to 8 inch d.b.h.
	3	Loblolly-Virginia pine stand with mixed hardwood
	4	Mixed hardwood with shortleaf pine
	14 (added in 1970)	Loblolly pine plantation, 2 to 6 inch d.b.h.
Lookout Mountain (Control)	11	Loblolly pine plantation, 4 to 8 inch d.b.h.
	12	Shortleaf-loblolly-Virginia pine stand with mixed hardwood
	13	Mixed hardwood with shortleaf pine

two chains (132 feet or 40.4 m). Stand structure, site conditions, and stocking of each pair of plots were as similar as possible. The plots at each sampling point were within 5 chains (101 m) of each other and were oriented along a given magnetic compass bearing. This condition facilitated photo coverage of both plots in one flight line. Individual sampling points were located at least a quarter mile apart.


1/5 acre
plot
1/5 acre
plot
variable distance - less than 5 chains (101 m)
common axis of 2 plots at each sampling point

For each plot, the stem location of every tree visible from the air was mapped. The trees on the plot were each permanently tagged and numbered on the ground.

Field crews marked the corners of each plot with 18-inch-wide butcher paper in 10-foot lengths placed in the form of an "L". Panel markers in the form of a "T" were placed several chains ahead of each plot pair where openings were available. This placement helped us find the plots from the air.

Data Collection

Field crews from the TVA collected all of the plot data for our feasibility test. The TVA will also use these data for a long-term ground survey designed "to determine the extent to which the operation of the Widows Creek Steam Plant has affected the appearance, growth, and survival of timber stands in the area surrounding the plant".[2] Photographic records of SO_2 injury and the photo interpretation data from our remote sensing feasibility test will contribute information to this ground survey.

During summer TVA crews checked the study plots weekly to determine whether fume effects had occurred. The occurrence of effects on the plots was unpredictable because of dependence on (1) meteorological conditions which would cause ground-line fumigation on the plots, and (2) sensitivity of the tree species on the plots to SO_2 at the time of fumigation.

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[2] From "Work Plan for Forestry Surveillance Study in the Vicinity of Widow's Creek Steam Plant". May 1969. Tennessee Valley Authority, Div. of Forestry, Fisheries, and Wildlife Devel., Div. of Environmental Research and Devel., Div. of Power Resources Planning.

We conducted our feasibility test in the summer because the probability of fume effects occurring is highest in the late spring and early summer when growing conditions and, consequently, a plant's sensitivity to SO_2 are optimal. Conditions for photography are also best in summer—the weather is often clear, and the higher sun angle creates less shadows on photographs.

Field crews collected the following data on the crown condition of each tree on a plot (Attachment 1).[3] Photo interpreters later evaluated the trees on film and recorded these same items:

1. Tree number.
2. Species.
3. Tree condition (unaffected, slightly, moderately or severely affected by SO_2).
4. Crown color:
    a. Approximate: normal, slightly to moderately discolored, or severely discolored (not recorded by photo interpreters).
    b. Munsell hue, value, and chroma.[4]

The following additional information was also collected for each tree in the field:

1. Status (live, cut or destroyed, or dead).
2. D.b.h. (diameter at breast height)
3. Merchantable height.
4. Top d.i.b. (diameter inside bark)
5. Tree grade.
6. Cull.
7. Crown class.

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[3] All attachments are shown in the first part of the APPENDIX.

[4] Munsell Color Company. Munsell Book of Color. Ed. 1920-60. Baltimore, Md.

8. Current foliage condition
    a. Year produced.
    b. Premature cast.
    c. Needle length (conifers only).
    d. Percent of needles or leaves showing tip dieback or necrosis.
    e. Average percent of dieback on affected leaves or needles.
    f. Approximate color of needles (conifers only).
9. Condition of previous-year needles (conifers only):
    a. Premature cast.
    b. Needle length.
    c. Percent of needles showing tip dieback.
    d. Average percent of dieback on affected needles.
    e. Approximate color of needles.
10. Current shoot growth.
11. Cone crop.
12. Conelet crop.

AERIAL PHOTOGRAPHY

While ground data were being collected and immediately thereafter, members of the remote sensing research unit photographed all plots from the air. We used two Maurer 70 mm. aerial cameras, with 6-inch lenses, mounted, in a Forest Service Aero Commander 500B. Anscochrome D/200 and Ektachrome IR films were exposed simultaneously over each plot at three different scales (Table 2).

In 1969, a didymium (rare earth) filter and a haze filter (HF-3) were each tested with Anscochrome D/200 film at 1:1,584 scale to find out which combination was best for enhancing the appearance of SO_2-affected trees. In earlier studies by Wert et al. [4, 5], the combination of Anscochrome D/200 film and a didymium filter was used successfully for detection of air pollution damage to ponderosa pine (Pinus ponderosa Laws.) in the mountains around Los Angeles, California.

Table 2. Film-filter-scale combinations used to photograph SO_2 injury on study plots, 1969 and 1970.

YEAR	SCALE	FILM	
		Ansco D/200	Ekta IR
1969	1:1,584	Didymium	Wratten 15
	1:1,584	HF-3	Wratten 15
	1:3,960	HF-3, 1A	Wratten 15
	1:7,920	HF-3, HF-4	Wratten 15
1970	1:800	Didymium	Wratten 12
	1:1,584	Didymium	Wratten 12
	1:3,960	HF-3, HF-4	Wratten 12

The two smaller scales of color coverage used in 1969--1:3,960 and 1:7,920--were flown with D/200 and haze filters. Haze filters must be used at these higher altitudes to penetrate haze which scatters light more at the blue end of the spectrum. Color films taken with the didymium or no filter would appear too blue.

From the 1969 test, we learned that the 1:7,920 scale was too small for successful detection of SO_2 injury, so it was replaced in the 1970 test by the 1:800 scale. We tested the 1:800 scale on only four pairs of plots: two SO_2-affected and two control. In 1970, all of the D/200 color films at 1:800 and 1:1,584 were used with the didymium filter. The 1969 test had shown this combination to be best for detection of SO_2 injury at large scales. Examples of this photography are shown for both years, two films, and three scales (Figs. 4a and 4b).

All films were processed to transparencies in the TVA photo lab following completion of the photography.

PHOTO INTERPRETATION

To prepare for photo interpretation, we cut out photo coverage of each plot at each of the film-filter and scale combinations. The emulsion of every strip of film was protected with a backing of clear plastic and the strip labeled as to its film type, filter, scale, and plot.

Four interpreters examined all photo coverage in both years--three were from TVA and one from HEW. They were trained to recognize crown characteristics of affected and nonaffected trees on photography outside of the study plots. A trip to the field and comparison of tree images on the photos with the same trees on the ground gave them further background.

Each interpreter examined all films stereoscopically at 2 to 4X magnification over a balanced light source. To avoid biased interpretation the films were ordered so that no plot was looked at twice in a row. On a template for each film the interpreter plotted and numbered only trees which appeared to have been affected by SO_2. The tree number, level of effect (trace, moderate, or severe) and species (loblolly pine, Virginia pine, shortleaf pine, or hardwood) were recorded (Attachment 2).

Later, two members of the remote sensing research unit made Munsell color readings on some of the films by using a Munsell color comparator [1] (Fig. 5). The readings were made on all trees on two of the pairs of plots of the 1970 photography. Color film at the 1:1,584 scale was used in this work.[5] Both pairs of plots were in the affected area. Color of healthy and affected trees was recorded. Approximately 325 trees were assigned hue, value and chroma as seen on the color film.

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[5] Munsell readings were made only on trees which were distinguishable on the film and had sunlit crowns.

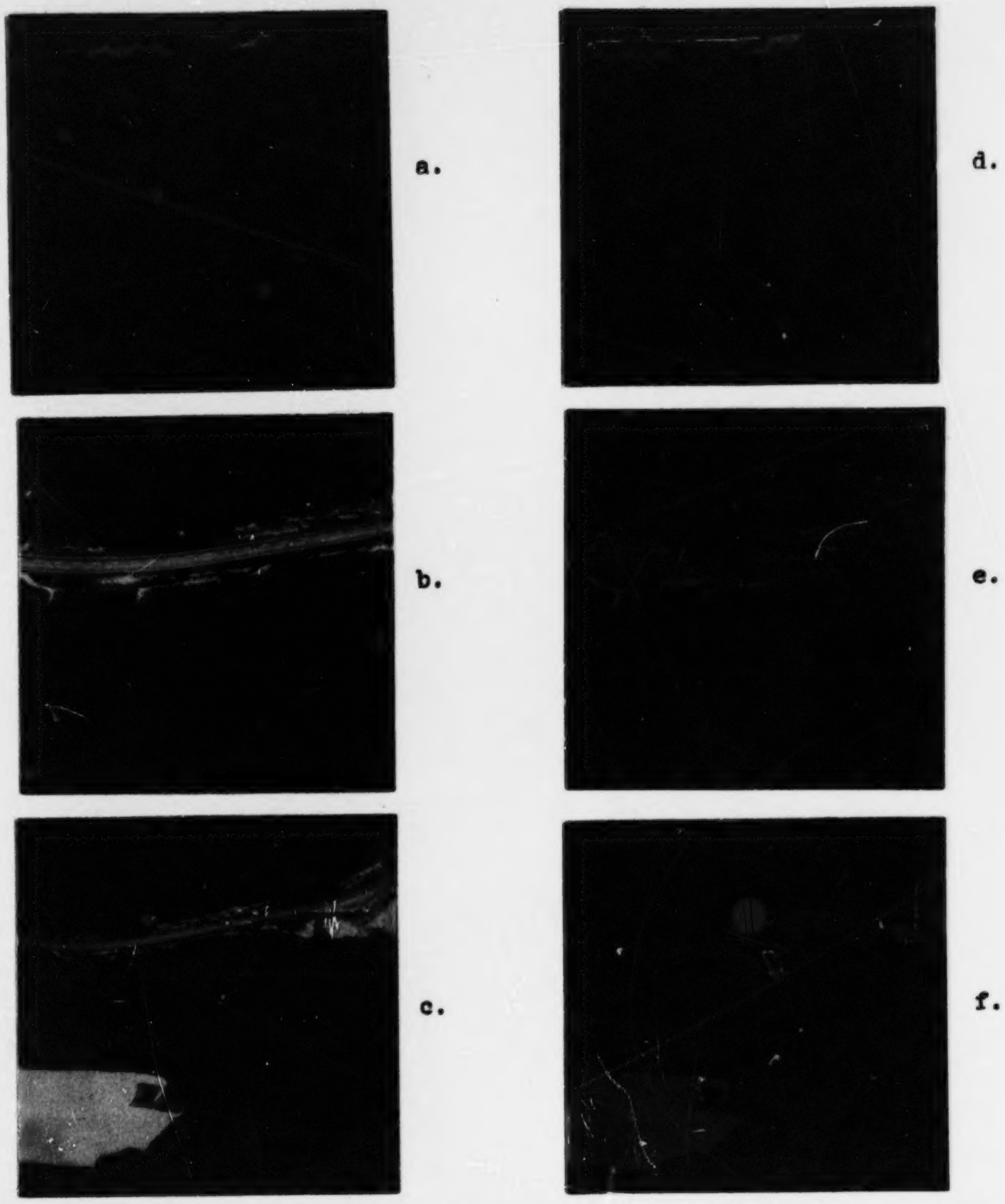

Figure 4a. Examples of films and scales used in 1969 SO_2 injury study. Plot 3 is shown. Note difference in level of fumigation between 1969 and 1970.

a. 1:1,584 scale, color film/didymium filter
b. 1:3,960 scale, color film/HF-3, 1A filters
c. 1:7,920 scale, color film/HF-3, HF-4 filters
d. 1:1,584 scale, IR film/15 filter
e. 1:3,960 scale, IR film/15 filter
f. 1:7,920 scale, IR film/15 filter

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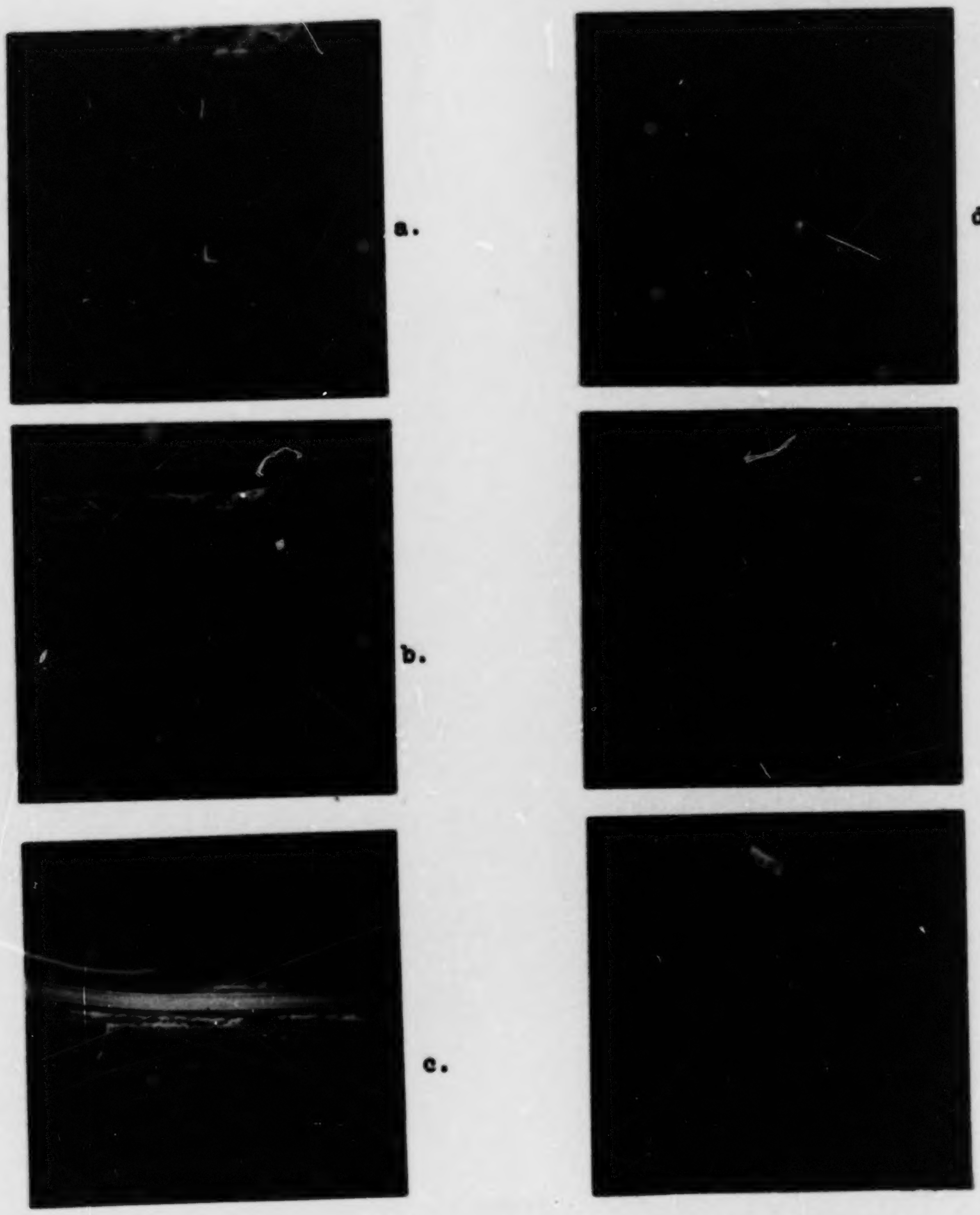

Figure 4b. Examples of films and scales used in 1970 SO_2 injury study. Plot 3 is shown.

a. 1:800 scale, color film/didymium filter
b. 1:1,584 scale, color film/didymium filter
c. 1:3,960 scale, color film/HF-3, HF-4 filters
d. 1:800 scale, IR film/12 filter
e. 1:1,584 scale, IR film/12 filter
f. 1:3,960 scale, IR film/12 filter

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Figure 5. Munsell color comparator permits photo interpreter to assign Munsell hue, value, and chroma to images of healthy and SO_2-affected trees.

Munsell hues in the red to purple range are difficult to copy on transparency film. These hues are needed to make Munsell readings of tree images on IR film, using the color comparator. To date, our attempts to copy the reds and purples have been unsuccessful, so we were unable to make any Munsell readings on IR film. We plan to pursue this problem in future studies, however, as hue is probably a major factor in detection of stress on IR film.

PHOTO INTERPRETATION - GROUND CORRELATION

To evaluate photo interpretation (PI) accuracy, our first step was to correlate the PI records and film templates with the ground truth records and plane table maps. Each tree which an interpreter had circled on a template had to be identified by its number on the ground. We did this by making "ground truth templates" using the plane table map as a guide. The location and number of every SO_2-affected tree was plotted on a template for each different plot and scale. This ground truth template could then be laid over an interpreter's template (of the same scale and plot), quickly showing which affected trees the interpreter had correctly identified. Commission errors were also obvious. Since there were a great many PI templates for each year (4 interpreters each looked at 7 or 8 different plots photographed on 3 different film-filter types at 3 scales) the ground truth templates greatly hastened correlation.

The correlation stage resulted in a union of the ground truth data with the PI data for each tree on each plot at each different film-filter-scale-interpreter combination. All of this data was then keypunched on IBM cards for tabulation and analysis.

RESULTS

SPECIES AND CONDITION TABLES

The first step in the analysis was to summarize the large quantity of data in some descriptive way. We have two years of data taken with two films, three scales, two filters, and four interpreters. A summary was needed for two reasons: one to determine how well each photo interpreter did in identifying the species of affected trees and tree condition (level of SO_2 injury), and the other to be able to compare these results for different interpreters and different film-filter-scale combinations. Contingency tables were set up--one on species identification (Table 3) and one on tree condition identification (Table 4). This was done for each interpreter-film-filter-scale combination--a total of 29 pairs of tables for 1969 and 24 for 1970. In 1969 interpreters each viewed over 8400 trees in making their decisions. The data entries in a table are sums of trees over all plots (both affected and nonaffected) covered for a particular combination. As the number of plots varies, totals will be different in the various tables. Tables derived from data for only one interpreter are shown in the text of this report. Data for the other interpreters, years and film-filter combinations are shown in the APPENDIX.

The table heading "interpreted" refers to the photo interpreter's identification of species or condition type, while "actual" is the type determined by the ground crew. Interpreted data are by row and the ground data by column. The entries along the diagonal of the tables are the number of correct identifications by the interpreter. For example, in Table 3 entry a_{21} (column 2, row 1) informs the reader that 3 trees were typed VP (Virginia pine) which were actually LP (loblolly pine). Similarly, entry a_{44} indicates that 20 hardwoods were identified correctly.

The "committed" column reflects the number of times an interpreter identified an affected tree when no tree was shown to exist on the plane table map. We found that in addition to mistakenly identifying bushes, rocks, etc., as trees, interpreters sometimes identified small trees on the photos that had not been mapped by the field crews who felt these overtopped trees would not be visible. This problem could be solved by remapping these smaller trees; they should not be included as commission errors.

The final column "PI Totals" gives the total number of trees, plus commission errors, the interpreter said were of a certain type. The last row serves the same function by giving the totals of the actual types. The final figure is the grand total of all the trees considered.

In a few instances, there are fractional entries in a table. These represent the case where one tree was interpreted as two or more trees, and each one was assigned a different type.

Table 3. Comparison of photo interpreter's identification of tree species with the ground truth. Interpreter BN, color film at 1:800 scale with didymium filter.[1] 1970.

Interpreted Species	Actual Species					
	LP	VP	SP	HDW	Committed	PI Totals
	Number of trees					
LP	41	3	0	1	2	47
VP	1	23	0	0	4	28
SP	4	0	0	0	0	4
HDW	0	1	0	20	3	24
Affected & Omitted[2]	22	20	0	17		59
Ground Total Affected[3]	68	47	0	38		153
Ground Totals[4]	93	48	0	58	9	199

LP - loblolly pine

VP - Virginia pine

SP - shortleaf pine

HDW - hardwood

Committed - commission errors

[1] Tables 3 and 4 are copied from computer printouts and show the legend and explanation for similar tables in the APPENDIX.

[2] Number of affected trees which interpreter said were unaffected, by species.

[3] Total number of affected trees.

[4] Includes both affected and unaffected trees.

Table 4. Comparison of a photo interpreter's identification of level of affect with the ground truth. Interpreter BN, color film at 1:800 scale with didymium filter. 1970.

Interpreted Condition	Actual Species					
	UA	Trace	MA	SA	Committed	PI Totals
	---------- Number of trees ----------					
Omitted[1]	22	29	12	18		81
Trace	6	15.5	4.5	0	2	28
MA	17	21.5	16.5	13	6	74
SA	1	0	4	19	1	25
Affected[2]		37	25	32		94
Ground Totals	46	66	37	50	9	199

UA - unaffected

Trace - trace of affect

MA - moderately affected

SA - severely affected

Committed - commission errors

[1] Number of trees which interpreter said were unaffected, by level of affect.

[2] Total number of trees which interpreter said were affected (sum of rows 2-4).

ANALYSIS OF DATA

One of the objects of the study was to determine how the use of different film-filters, different scales, and different interpreters affects accuracy. The first step in this analysis was to test the null hypotheses that each of these factors had no effect. A suitable test for this purpose is the χ^2 (chi-square) for which the properties of normality and equal variances are not required.

Tests for Interpreters

For the test between interpreters, all of the 1969 data were combined into 4 tables (Table 5). Two hypotheses were tested: (1) the interpreters' performances in identifying both affected trees and unaffected trees were alike, and (2) the interpreters' performances in identifying only affected trees were similar. The test of (1) was based on data for all trees; the test of (2) was based on data for affected trees only. The computed χ^2 values were high for both hypotheses, so both were rejected at the 99% level. This analysis gave no clue to the nature of the differences. Results were compared for pairs of interpreters, and significant differences were found between each pair as well. To evaluate performance two percentages were computed. The first was the percentage of trees correctly identified as affected and nonaffected. These values for interpreters 1 through 4 were 78.5%, 79.6%, 79.1%, 79.5%, respectively. We realized that this was not a good criterion for evaluation of performance because if an interpreter had called every tree unaffected his score would have been 80.5%. In other words, fumigation effects were light in 1969, and few trees were affected. The second computation was the percentage of affected trees correctly identified as affected. These values for interpreters 1 through 4 were 19.1%, 25.1%, 14.3%, and 17.4% for all scales and film-filters. Again these low accuracies are a reflection of the light fumigation effects in 1969 and also the inclusion of the small scales. Interpreter 2's results were superior by both criteria, but the values of the two percentages seem unrelated for the other three interpreters.

A test for interactions was then performed. This was designed to answer questions such as:

1. Is one interpreter better than another for one film-filter and scale and worse for others?

2. Can differences between results for only one or two film-filter and scale combinations account for the significance of the combined test?

Some of the results can be found in Table 6. Note the improvement in performance as the images and scales became larger. Refer back to Figure 4 to see the difference in film response between the two years, 1969 and 1970, as a result of the differences in fumigation levels.

Table 5. 1969 photo interpretation and ground comparisons summed for all film-filters and scales. Total trees on plots - 8429.

Interpreter	Ground Analysis	Photo Interpretation Analysis Tree affected	 Tree unaffected	Totals
		Numbers of trees		
1	Affected	314	1328	1642
	Unaffected	486	6301	6787
2	Affected	412	1230	1642
	Unaffected	491	6296	6787
3	Affected	235	1407	1642
	Unaffected	356	6431	6787
4	Affected	286	1356	1642
	Unaffected	376	6411	6787

Legend:	**Affected**	**Correct**	**Omitted**
	Unaffected	**Committed**	**Correct**

Table 6. 1969 data - affected trees only. Percentage correctly identified.

		Scale		
Interpreter	Film-filter	1:1,584	1:3,960	1:7,920
1	Color 1A	32.2*	17.4**	5.5*
	IR-12	30.1	19.1**	5.1**
	Color-D	24.8**		
2	Color 1A	28.8	22.0	12.3
	IR-12	32.2	24.6	12.7
	Color-D	43.8		
3	Color 1A	22.0	8.5	7.6
	IR-12	24.2	9.8	1.7
	Color-D	27.0		
4	Color 1A	24.2	15.7	6.8
	IR-12	25.0	13.6	6.8
	Color-D	30.5		

* There were significant differences between interpreters at the 95% level for this film-filter and scale.

** There were significant differences between interpreters at the 99% level for this film-filter and scale.

Similar analyses were carried out for the 1970 data. Again highly significant differences were apparent between interpreters. The percentages of all trees correctly identified for the 1970 data were 76%, 80%, 80%, and 80%.[6] (Interpreters numbered 2 and 3 are not the same people as the correspondingly numbered interpreters for the previous year.) The percentages for affected trees correctly identified were 28%, 32%, 34%, and 28%. The magnitude of these percentages is greater than for 1969 because more interpretation was done on large-scale film, and fumigation effects were greater in 1970 than in 1969.

The 1970 test for interactions again demonstrated differences between interpreters for most film-filters and scales. Table 7 is informative for evaluating the interpreters' performances for these combinations. There is both an improvement by year, 1970 over 1969, and by scale, 1:800 over all others.

Another test for differences between interpreters was executed for only the 1970 data. The object of this test was to see how well the interpreters classified the severely affected trees as being affected. For all scales of film and all film-filter combinations the interpreters were able to recognize severely affected trees better. A comparison of Tables 7 and 8 demonstrates this. This result is encouraging.

Tests for Scales

The same two null hypotheses were tested for scales as were tested for interpreters: (1) the overall performance of interpreters at the different scales was the same, and (2) there were no differences in the identification of affected trees by scale. Examination of the data by eye revealed that the differences in interpretation accuracies between scales were so great that statistical tests were unnecessary. The statistical tests verified this--each was significant at the 99.99% level.

A summary table (Table 9) showing average percentages correct for all interpreters gives an indication of the magnitude of the differences between scales. Note that these differences are less pronounced when the analysis is done on severely affected trees only. Obviously the larger the scale, the more accurate the results.

Tests for Film-Filters

For 1969 data, the hypothesis that all film-filters are equivalent for the identification of affected trees was rejected at the 98% level. At the 1:7,920 scale the results were mixed. At 1:3,960 EIR-12 yielded a higher percentage than Color-1A for three of the four interpreters. For the 1:1,584 scale the ranking was Color-D, EIR-12, and Color-1A for three out of four of the interpreters.

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[6] These percentages include both affected and unaffected trees.

Table 7. 1970 data - affected trees only. Percentage identified as affected. Comparison of 4 interpreters, 3 scales, and 2 films.

Interpreter	Film-filter	Scale 1:800	 1:1,584	 1:3,960
1	Color HF			8.0**
	IR-12	55.1	32.0*	18.7*
	Color-D[1]	62.5**	28.3**	
2	Color HF			22.5
	IR-12	46.6	36.0	21.1
	Color-D	47.2	36.1	
3	Color HF			16.2
	IR-12	53.4	37.9	20.1
	Color-D	62.5	42.2	
4	Color HF			17.3
	IR-12	48.3	30.4	13.8
	Color-D	51.1	30.4	

* Interpreters' results were significantly different at the 95% level

** Interpreters' results were significantly different at the 99% level

[1] Color film with the didymium filter is not taken at scales smaller than 1:1,584.

Table 8. 1970 data - severely affected trees only. Percentage identified as affected. Comparison of 4 interpreters, 3 scales, and 2 films.

Interpreter	Film-filter	Scale 1:800	 1:1,584	 1:3,960
1	Color HF			10.6**
	IR-12	73.6	59.5**	40.0**
	Color-D	64.2**	50.6**	
2	Color HF			49.4
	IR-12	75.5	71.4	47.1
	Color-D	81.1	60.0	
3	Color HF			41.2
	IR-12	86.8	75.0	52.9
	Color-D	90.6	72.9	
4	Color HF			50.6
	IR-12	83.0	69.1	36.5
	Color-D	77.4	67.1	

** Interpreters' results were significantly different at the 99% level

Table 9. Average for all interpreters of the percentages of affected trees correctly identified as affected for 1969 and 1970.

ALL AFFECTED TREES

		Scale			
Year	Film-filter	1:800	1:1,584	1:3,960	1:7,920
		Percent			
	Color-1A	Not flown	26.8	15.9	8.1
1969	IR-12		27.9	16.7	6.6
	Color-D		31.5		
	Color-HF			16.0	Not flown
1970	IR-12	50.9	34.1	18.5	
	Color-D	55.9	34.3		
		SEVERELY AFFECTED TREES ONLY			
	Color-HF			37.9	Not flown
1970	IR-12	79.7	68.8	44.1	
	Color-D	78.3	62.6		

In 1970 the Color-D was again the highest ranking film-filter combination. Color-1A and EIR-12 were compared for the 1:3,960 scale and ranked the same. Color-D and EIR-12 were compared at the 1:800 and 1:1,584 scales, and Color-D ranked consistently better. This confirmed the 1969 results that Color-D was in general the best combination. The χ^2 test revealed that the differences were significant at the 99% level.

Correlation Analysis

The correlation matrices show the strength of the relationship between different pairs of ground variables. Matrices were computed for six different categories of trees in both years: (1) a composite of all affected pine species from all plots, (2) all affected hardwoods, (3) all affected trees (pines and hardwoods), (4) unaffected pines, (5) unaffected hardwoods, and (6) all unaffected trees. This approach enabled us to examine differences or similarities in the relationships between variables for different species, levels of affect, and years. Two of the matrices, affected pines in 1969 and 1970, are shown in Tables 10 and 11. The rest are in the APPENDIX.

The abbreviations used for variables on the matrices are explained in Table 12. Notice that the order and number of variables change from 1969 to 1970.

Columns and rows of zeros in the matrices do not represent valid correlations. The zeros indicate that either (1) data were not recorded for those variables (e.g., needle length was not recorded for hardwoods), or (2) the value for the variable was recorded the same for all observations (e.g., for unaffected pines there was no needle dieback). Though a relationship may exist between variables which have a constant value, this type of analysis will not show it.

In the correlation matrix, a value called the correlation coefficient is recorded for each pair of variables (intersection of a row and a column). Interpretation of the correlation coefficient depends on n, the number of pairs of observations between the pair of variables. The range of n is given on each matrix.

Underlined coefficients are significant at the 99% level. This means that the probability of getting this high a correlation coefficient for this number of observations, if there is in fact no relationship between the variables, is less than 1%. The value of the 99% significance level depends on n; as n increases the 99% significance value decreases.

When the number of observations is large the correlation coefficient indicates how strongly the pair of variables is related. As n increases, the sampling error becomes small, and these estimates of the correlation coefficient are precise indicators of the strength of the relationship between the variables in the entire population. In many cases we have large n's and coefficients as high as 0.65 or greater. This indicates a great deal of dependence between the variables.

TVA AIR POLLUTION STUDY 1969

SPECIES PINE AFFECTED TREES

Table 10. Correlation matrix from 1969 ground variables for SO_2-affected pines. Additional matrices for 1969 and 1970 are in the APPENDIX.

n ranges from 133-189

Underlined coefficients significant at 99% level

	CRCL	DBH	HUE	VAL	CHRO	COND	LEN	DNOT	DNLN	CAST	LEN	DNOT	DNLN	CAST	SHGR
CRCL	1.00														
DBH	-.46	1.00													
HUE	-.03	.09	1.00												
VAL	-.01	-.07	-.33	1.00											
CHRO	.03	-.12	-.01	.40	1.00										
COND	.01	.07	.17	.00	-.01	1.00									
LEN	-.14	.08	-.10	.12	-.06	.00	1.00								
DNOT	.07	-.08	-.33	.03	.07	-.57	.10	1.00							
DNLN	.07	-.04	-.38	.02	-.05	-.50	.14	.68	1.00						
CAST	-.07	.01	-.17	.20	.06	.00	.58	.14	.10	1.00					
LEN	.21	-.20	-.28	.03	-.05	-.13	.33	.21	.24	.28	1.00				
DNOT	-.08	-.03	-.10	.18	.07	.08	.07	-.14	-.27	.17	.19	1.00			
DNLN	-.10	.04	-.04	.06	-.05	.16	.06	-.21	-.30	.13	.07	.80	1.00		
CAST	-.03	.01	-.27	.15	.04	-.07	.53	.31	.26	.52	.58	.26	.13	1.00	
SHGR	.18	-.19	-.22	.07	-.05	-.08	.40	.31	.24	.34	.64	.14	.09	.69	1.00

T AIR POLLUTION STUDY 197

SPECIES PINE AFFECTED TREES

Table 11. Correlation matrix from 1970 ground variables for SO_2-affected pines.

n ranges from 119-348

Underlined coefficients significant at 99% level.

	COND	CRCL	APXC	HUE	VAL	CHRO	CAST	LEN	DNOT	DNLN	APXC	CAST	LEN	DNOT	DNLN	APXC	SHGR	CONE	CNLT
COND	1.00																		
CRCL	$\underline{.24}$	1.00																	
APXC	$\underline{.94}$	$\underline{.25}$	1.00																
HUE	$-\underline{.69}$	$-\underline{.23}$	$-\underline{.74}$	1.00															
VAL	-.10	-.15	-.10	$\underline{.37}$	1.00														
CHRO	$\underline{.55}$	.11	$\underline{.59}$	$-\underline{.63}$	.10	1.00													
CAST	.12	-.04	.12	-.01	$\underline{.17}$	.07	1.00												
LEN	$\underline{.55}$	$\underline{.44}$	$\underline{.56}$	$-\underline{.42}$	.04	$\underline{.47}$	.09	1.00											
DNOT	$\underline{.91}$	$\underline{.21}$	$\underline{.88}$	$-\underline{.71}$	$-\underline{.16}$	$\underline{.52}$	-.03	$\underline{.51}$	1.00										
DNLN	$\underline{.82}$	$\underline{.28}$	$\underline{.84}$	$-\underline{.75}$	$-\underline{.20}$	$\underline{.53}$	-.03	$\underline{.50}$	$\underline{.85}$	1.00									
APXC	$\underline{.91}$	$\underline{.25}$	$\underline{.96}$	$-\underline{.71}$	-.07	$\underline{.59}$	.12	$\underline{.60}$	$\underline{.87}$	$\underline{.82}$	1.00								
CAST	$\underline{.57}$	$\underline{.25}$	$\underline{.58}$	$-\underline{.44}$	-.03	$\underline{.37}$	$\underline{.17}$	$\underline{.54}$	$\underline{.55}$	$\underline{.48}$	$\underline{.57}$	1.00							
LEN	$\underline{.41}$	$\underline{.32}$	$\underline{.40}$	$-\underline{.29}$	.07	$\underline{.27}$	.12	$\underline{.65}$	$\underline{.39}$	$\underline{.40}$	$\underline{.44}$	$\underline{.48}$	1.00						
DNOT	$\underline{.50}$	.09	$\underline{.51}$	$-\underline{.42}$	-.09	$\underline{.26}$	.06	$\underline{.32}$	$\underline{.48}$	$\underline{.47}$	$\underline{.50}$	$\underline{.43}$	$\underline{.36}$	1.00					
DNLN	$\underline{.39}$	.08	$\underline{.46}$	$-\underline{.33}$	-.06	$\underline{.26}$	.09	$\underline{.29}$	$\underline{.40}$	$\underline{.37}$	$\underline{.45}$	$\underline{.43}$	$\underline{.34}$	$\underline{.72}$	1.00				
APXC	$\underline{.63}$	.05	$\underline{.65}$	$-\underline{.44}$	.09	$\underline{.42}$	$\underline{.16}$	$\underline{.43}$	$\underline{.62}$	$\underline{.57}$	$\underline{.66}$	$\underline{.57}$	$\underline{.49}$	$\underline{.76}$	$\underline{.66}$	1.00			
SHGR	$\underline{.55}$	$\underline{.37}$	$\underline{.54}$	$-\underline{.29}$	.07	$\underline{.39}$	$\underline{.19}$	$\underline{.69}$	$\underline{.49}$	$\underline{.42}$	$\underline{.55}$	$\underline{.61}$	$\underline{.58}$	$\underline{.35}$	$\underline{.35}$	$\underline{.50}$	1.00		
CONE	.13	-.05	.03	.06	.13	-.04	-.01	.07	.04	.08	.05	.01	.17	.08	.06	.13	-.02	1.00	
CNLT	.05	-.13	-.02	.04	.21	.06	-.01	.11	.06	.02	.06	.05	.11	[illegible]	-.01	.04	.01	.35	1.00

Table 12. Ground variables listed in the column and row headings of the correlation matrices.

1969

1. CRCL - crown class
2. DBH - d.b.h.
3. HUE - Munsell hue
4. VAL - Munsell value
5. CHRO - Munsell chroma
6. COND - tree condition
7. LEN - current needle length
8. DNOT - % of current needles or leaves showing tip dieback
9. DNLN - average % of dieback on affected current needles or leaves
10. CAST - current needle cast
11. LEN - previous year needle length
12. DNOT - % of previous year needles showing tip dieback
13. DNLN - average % of dieback on affected previous year needles
14. CAST - cast of previous year needles
15. SHGR - current shoot growth

1970

1. COND - tree condition
2. CRCL - crown class
3. APXC - approximate crown color
4. HUE - Munsell hue
5. VAL - Munsell value
6. CHRO - Munsell chroma
7. CAST - current needle cast
8. LEN - current needle length
9. DNOT - % of current needles or leaves showing tip dieback
10. DNLN - average % of dieback on affected current needles or leaves
11. APXC - approximate color of current needles
12. CAST - cast of previous year needles
13. LEN - previous year needle length
14. DNOT - % of previous year needles showing tip dieback
15. DNLN - average % of dieback on affected previous year needles
16. APXC - approximate color of previous year needles
17. SHGR - current shoot growth
18. CONE - cone crop
19. CNLT - conelet crop

The correlation matrices gave us the first clue as to what ground variables may be related to each other.

On the affected pine matrix, 1969, (Table 10) the percent of current needles with tip dieback (DNOT) and the length of current tip dieback (DNLN) both appear to be strongly related to tree condition as well as to each other. Other variables, such as cast and needle length, percent of previous year needle tip dieback and length of previous year tip dieback appear strongly related to each other but not to tree condition.

In 1970 the same relationships as above were highly significant for affected pines (Table 11). Many new relationships also showed up due to the greater number of affected trees and the severity of the fumigation in 1970. Approximate crown color, Munsell hue and approximate current needle color were strongly related to tree condition. It is also interesting to note that hue, approximate crown color, and approximate current needle color are also related to tip dieback.

On the 1969 affected hardwood matrix no variables are significantly related to tree condition, while in 1970 the percent and length of current tip dieback (DNOT and DNLN) are both related to condition. This is again probably due to the severity of fumigation in 1970.

The unaffected tree matrices for both years reveal expected relationships such as: hue--approximate color, cone--conelet crop, previous year needle tip dieback--length of tip dieback.

Multivariate Linear Discriminant Analysis

Another phase of the statistical analysis was designed to find out what the photo interpreters should look for when trying to identify damaged trees. The correlation matrices indicate how strongly the pairs of variables studied are related to each other and how strongly each is related to condition class.

The multivariate linear discriminant analysis is a method designed to answer directly queries such as: How well can condition class be predicted from the ground variables? The importance of the variables entered can be evaluated by Hotelling's T-squared statistic or by comparing the models with and without a variable using the U statistic. Table 13 shows the probabilities that each variable contributed toward the results of the test; the null hypothesis assumed is that the variable has no effect on the results. High values in this table indicate that the variable contributes more to the analysis.

Significant variables that can be seen on the photographs may account for the success of the interpreters. For example, it is likely that two of the significant variables, approximate needle and crown color, are important and identifiable by the photo interpreters. On the other hand, had needle length been the only variable of importance it is unlikely that the interpreters could have been successful. Other variables which fell below 0.95 lend little to identification of fumigation injury.

Table 13. Importance of ground variables related to determining level of affect of fumigation on trees. (Numbers in the table are 1 - P $\{\hat{\beta}_i$ is of this magnitude or greater $| \beta_i = 0\}$ where β_i and $\hat{\beta}_i$ are the coefficient and its estimate for variable i in the linear discriminant model.)

Variable	1969	1970
Species	.610	.140
Crown Class	.789	.228
DBH	.325	
Hue	.920	.999**
Value	.311	.791
Chroma	.037	.997**
Approximate current needle color		.999**
Current needle length	.999**	.784
Current dieback - % of needles with tip dieback	.999**	.999**
Current dieback - average % of dieback on affected needles	.999**	.999**
Current dieback - % of premature cast	.991**	
Previous year approximate needle color		.999**
Previous year needle length	.899	.727
Previous year dieback - % of needles with tip dieback	.209	.995**
Previous year dieback - average % of dieback on affected needles	.999**	.999**
Previous year dieback - % of premature cast	.957*	.999**
Current shoot growth	.740	.512
Current cone crop		.209
Current conelet crop		.949*
Approximate crown color		.999**

* Significant at the 95% level
** Significant at the 99% level

Species, crown class, d.b.h., Munsell value, shoot growth and current cone crop have been well demonstrated to be unrelated to SO_2 injury. Further study will be needed to determine whether chroma is a useful variable or is a statistical anomaly. The fact that these variables were nearly constant may account for the varied results. The other borderline variable is current conelet crop. Further study might indicate that this is an important variable.

RECOMMENDATIONS

Because of certain reoccurring problems encountered during data analysis we suggest making the following changes in any future studies:

1. In many instances the photo interpreters identified small trees on the film which were not shown on the plane table maps. These trees may have been considered to be not visible from the air (the criterion for exclusion from the maps). A careful ground check should be made and these trees added to the maps if necessary.

2. To facilitate keypunching of the photo interpretation data, the data sheet format should be changed. A tabular form is easier for the keypuncher to read, causing fewer mistakes to be made. The "level of affect" and "species" column entries should be entered the same way as they are on the ground data sheet. The "ground truth" column should include code numbers for situations such as tree out of plot, tree not on map, tree struck by lightning, or dying due to something other than SO_2 (Attachment 3).

3. A code is needed on the ground data sheets for spaces where no entry is made. The field crew should distinguish when (1) the entry does not apply to a particular tree (e.g., previous year needle length on a hardwood), (2) the observation was not made (e.g., Munsell readings are not made in the shade), or (3) the entry has a "0" value (e.g., percent needle cast on a healthy tree). Again, this code would make keypunching easier and would be more efficient.

4. No additional photography should be taken at scales smaller than 1:1,600; photo interpretation accuracies of SO_2 injury are unreliable when scales as small as 1:3,960 are used. No black and white (panchromatic or infrared) prints produced reliable estimates of SO_2 injury and need not be tried. Normal color exposed through a Corning didymium filter is the best film-filter combination to use.

5. For any future cooperative studies, the researchers involved should meet at the outset of the study. A discussion of the problem and definition of the purposes and goals of a new study would lead to sound statistical designs and ultimately to the most accurate results.

SUMMARY

1. In the spring of 1969 a research study was undertaken cooperatively between the TVA, the Forest Service, and the National Air Pollution Control Administration of HEW to investigate remote sensing methods useful to efficiently evaluate SO_2 injury to forest vegetation.

2. Paired and replicated ground plots were established by forestry personnel of TVA in fumigated and nonfumigated areas. Ground data were taken in a similar manner to that obtained by the Forest Survey, Forest Service, USDA. Additional ground data were collected to relate to the aerial photographic phases of the study.

3. Aerial photographs were taken immediately after fumigations of the plots in June 1969 and July 1970. In the feasibility stage of the study, photo scales ranged from 1:1,584 to 1:7,920. A larger scale of 1:800 was flown in 1970 when data indicated that larger images might be helpful.

4. All films were processed and interpretations were made at the Engineering facilities of TVA in Chattanooga, Tennessee. Four interpreters examined two kinds of color films--Anscochrome D/200 and color infrared--at 3 scales, with various filters, for both years--1969 and 1970.

5. We found that:

a. Interpreters tested differently from each other when all scales, films and filters were combined. However, when interpretations from the best film and largest scale were compared, differences were less apparent. We feel that additional training before the next interpretation would eliminate differences.

b. The best film was normal color film (Anscochrome D/200 in this test) exposed through a Corning didymium rare-earth filter. Color IR film was next best.

c. A scale of 1:800 was better than all others; however, a scale of 1:1,584 would be adequate if some errors could be tolerated.

d. Unacceptable errors in assessing SO_2 injury on photos occurred at scales of 1:3,960 and 1:7,920.

e. Light levels of fumigation, such as occurred in 1969 (when fewer than 20 percent of the trees were affected), are difficult to assess on color aerial photographs.

f. Some of the ground variables which are related most to successful identification of SO_2 injury on color photographs are:

(1) approximate crown color

(2) approximate current needle color

(3) Munsell hue

(4) percent of current needles or leaves with tip dieback

(5) percent of tip dieback on current affected needles or leaves

g. Some of the variables measured on the ground, such as species, d.b.h., shoot growth, and crown class are needed information for ground analysis but do not help separate fumigated vegetation into injury classes.

h. Because of the variable and unpredictable occurrence of SO_2 fumigations, the impact on the forest vegetation is difficult to assess in a two-year period. Longer periods of time are needed to accumulate enough information from both the aerial photographs and the ground data to evaluate the total impact on the resource. The total effect of several years of fumigation can be likened to injury by scale insects (balsam woolly aphid on fir or citrus scale on citrus) whose populations vacillate from the effects of weather, predation, and insecticides. The impacts of both of these scale insects have been measured successfully using color aerial photography in Maine and Florida, respectively [2, 3].

i. Fumigation effects can be more effectively studied now that the feasibility stages of the study have been completed and programs written for rapid computer analysis of data. However, yearly re-examination would have to be made over a 5- to 6-year period to evaluate the total impact. From these data, efficient probability sampling surveys could be designed which should have nationwide applications to other point sources of noxious gases.

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APPENDIX

SUPPLEMENTAL FIELD RECORD SHEET -- CROWN CONDITION OF TREES ON PERMANENT PLOTS. PLOT SHEET __ OF __

1. PLOT NO.:	2. DATE:			12. CREW:						
27. TREE:										
a. NUMBER										
b. SPECIES										
c. DBH, INCHES										
d. CROWN CLASS										
e. CROWN COLOR a/										
f. CONDITION b/										
28. CURRENT NEEDLES:										
a. YEAR										
b. LENGTH c/										
c. DIEBACK, PCT. AFFECTED:										
(1) NEEDLES ON TREE										
(2) NEEDLE LENGTH										
d. PRM. NEEDLE CAST, PCT.										
29. PREVIOUS YEAR NEEDLES:										
a. YEAR										
b. LENGTH c/										
c. DIEBACK, PCT. AFFECTED:										
(1) NEEDLES ON TREE										
(2) NEEDLE LENGTH										
d. NEEDLE CAST										
30. CURRENT YEAR:										
a. SHOOT GROWTH c/										
b. CONE CROP d/										
c. CONELET CROP d/										
31. OTHER -- SEE SHEET										

Attachment 1a. Field data sheet used in 1969 to collect information on condition of individual trees on each plot.

a. MUNSELL COLOR DESIGNATION INDICATING HUE, VALUE AND CHROMA.
b. UNAFFECTED (UA), MODERATELY AFFECTED (MA), OR SEVERELY AFFECTED (SA)
c. NORMAL (N), INTERMEDIATE (I), OR STUNTED (S).
d. NONE (N), MEDIUM (M), OR HEAVY (H).

FIELD RECORD SHEET FOR INDIVIDUAL TREES ON PLOTS IN MERCHANTABLE STANDS

PLOT NO._____ DATE / / . LOT SHEET NO.__ OF __. CREW ______________________

13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25. CROWN COLOR				26. CURRENT FOLIAGE						27. PR YR NEEDLES					28. CURRENT YR			29.
TREE NO.	AZIMUTH	DISTANCE	SPECIES	STATUS	DBH	HEIGHT	TOP DIB	TREE GRADE	CULL	TREE COND	CR'N CLASS	APX	MUNSELL			YEAR	CAST	NEEDLE LENGTH	% DEAD TISSUE		APX COLOR	CAST	LENGTH	DIE-BACK, % AFF'D		APX COLOR	SHOOT GR	CONE	CONELET	REFERENCE
													HUE	VALUE	CHROMA				N.O.T.(DB) / L.O.T.	N.A.(DB) / L.A				N.O.T.	N.L.					
UNIT OR SYMBOLS																														
	°	FT.		L,C D,H	IN.	FT.	IN.	P 1-5 A-C	%	U,T M,S	D,C I,S	N MD SD					%	N,I S	%	%	N MD SD	%	N,I S	%	%	N MD SD	N,I S	N T. ·H	N T H	R- REMOTE SENSING

Attachment 1b. Field data sheet used in 1970.

WIDOWS CREEK STEAM PLANT AREA
(ALABAMA)
TVA - HEW - USFS

PLOT________________

SCALE________________

FILM ________________

TREE NO	AFFECTED		LEVEL OF AFFECTS			SPECIES				MUNSELL COLOR CODE	COMMENT
	YES	NO	TRACE	MODERATE	SEVERE	LP	VP	SP	HDW		

Attachment 2. Photo interpretation record sheet used by photo interpreters to enter data on SO_2-affected trees.

SO_2 INJURY STUDY

Photo Interpretation Data Sheet

Date ____________

Interpreter	Plot	Film	Filter	Scale	Photo Interpretation			Ground Data			Elapsed Time
					Tree No.	Level of Affect T, M, S	Species LP, SP, VP, HDWD	Ground Tree No.	Ground Level of Effect	Ground Remarks	

Attachment 3. Suggested format for future photo interpretation data sheet.

```
                      TVA AIR POLLUTION STUDY  1969

                           INTERPRETER    RN

                  1584 SCALE     D FILTER     COLOR FILM


  INTERPRETED                          ACTUAL
  CONDITION                           CONDITION

                                                                  PI
                  UA       TRACE       MA         SA    COMMITTED  TOTALS

*******************************************************************************
             *
             *
    OMIT'D   *   456.00    79.00     76.00     15.00              626.00
             *
             *
     TRACE   *    51.00    10.00      9.00      3.00      .00      73.00
             *
             *
     MA      *    33.00    10.00     14.00      1.00      .00      58.00
             *
             *
     SA      *     7.00     2.00      5.00      2.00      .00      16.00
             *
             *
             *
   AFFECTED  *             22.00     28.00      6.00               56.00
             *
             *
             *
*******************************************************************************
             *
    GROUND   *
    TOTALS   *   547.00   101.00    104.00     21.00      .00     773.00
             *
```

```
                  TVA AIR POLLUTION STUDY  1969

                         INTERPRETER    KN

                  1584 SCALE      D FILTER      COLOR FILM


  INTERPRETED
   CONDITION                       ACTUAL
                                  CONDITION

                 UA       TRACE        MA         SA      COMMITTED    PI
                                                                     TOTALS
*********************************************************************************
              *
              *
   OMITTD     *  456.00     69.00      48.00      10.00               583.00
              *
              *
   TRACE      *   67.00     17.00      19.00       1.00        .00    104.00
              *
              *
   MA         *   22.00     11.00      18.50       2.00       1.00     54.50
              *
              *
   SA         *    2.00      4.00      18.50       8.00       1.00     33.50
              *
              *
              *
  AFFECTED    *             32.00      56.00      11.00                99.00
              *
              *
              *
*********************************************************************************
              *
   GROUND     *
   TOTALS     *  547.00    101.00     104.00      21.00       2.00    773.00
              *
```

```
                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER   PNL

                  1584 SCALE     D FILTER     COLOR FILM


INTERPRETED                            ACTUAL
 CONDITION                            CONDITION

                                                                    PI
                   UA        TRACE       MA         SA     COMMITTED   TOTALS

*************************************************************************
                *
                *
   OMIT'D       *      518.00     81.00      68.00      8.00               675.00
                *
                *
   TRACE        *       22.00     16.00      20.00      4.00      1.00      63.00
                *
                *
    MA          *        6.00      4.00      15.00      8.00       .00      33.00
                *
                *
    SA          *        1.00       .00       1.00      1.00       .00       3.00
                *
                *
                *
  AFFECTED      *                 20.00      36.00     13.00                69.00
                *
                *
                *
*************************************************************************
                *
   GROUND       *
   TOTALS       *      547.00    101.00     104.00     21.00      1.00     773.00
                *
```

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER   DLM

                       1584 SCALE     D FILTER     COLOR FILM


   INTERPRETED                          ACTUAL
   CONDITION                           CONDITION

                                                                         PI
                    UA      TRACE        MA         SA     COMMITTED   TOTALS

*************************************************************************
               *
               *
     OMIT'D    *  492.00     87.00     67.00     11.00               657.00
               *
               *
     TRACE     *   43.00     12.00     18.00      2.00        .00     75.00
               *
               *
     MA        *   12.00      2.00     15.00      5.00        .00     34.00
               *
               *
     SA        *     .00       .00      4.00      3.00        .00      7.00
               *
               *
               *
    AFFECTED   *             14.00     37.00     10.00               61.00
               *
               *
               *
*************************************************************************
               *
     GROUND    *
     TOTALS    *  547.00    101.00    104.00     21.00        .00    773.00
               *
```

TVA AIR POLLUTION STUDY 1969

INTERPRETER RN

1584 SCALE 1A FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	867.00	77.00	66.00	17.00		1027.00
TRACE	98.50	14.00	27.33	4.00	.00	143.83
MA	65.50	14.00	13.67	.00	1.00	94.17
SA	9.00	.00	2.00	1.00	.00	12.00
AFFECTED		28.00	43.00	5.00		76.00
GROUND TOTALS	1040.00	105.00	109.00	22.00	1.00	1276.00

NOT REPRODUCIBLE

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER KN

1584 SCALE 1A FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	956.00	89.00	70.00	9.00		1124.00
TRACE	60.50	11.00	17.00	1.00	1.00	90.50
MA	13.50	3.00	13.50	6.00	3.00	39.00
SA	10.00	2.00	8.50	6.00	4.00	30.50
AFFECTED		16.00	39.00	13.00		68.00
GROUND TOTALS	1040.00	105.00	109.00	22.00	8.00	1275.00

```
                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER   PNL

              1584 SCALE     1A FILTER      COLOR FILM

INTERPRETED                          ACTUAL
CONDITION                           CONDITION

                                                                  PT
              UA        TRACE       MA         SA      COMMITTED  TOTALS

**************************************************************************
           *
           *
  OMIT'D   *   973.00     89.00     76.00     14.00              1152.00
           *
           *
  TRACE    *    54.00     11.00     19.00      1.00      2.00      87.00
           *
           *
  MA       *    13.00      5.00     12.00      6.00       .00      36.00
           *
           *
  SA       *      .00       .00      2.00      1.00      1.00       4.00
           *
           *
           *
 AFFECTED  *              16.00     33.00      8.00                57.00
           *
           *
           *
**************************************************************************
           *
 GROUND    *
 TOTALS    *  1040.00    105.00    109.00     22.00      3.00    1276.00
           *
```

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                         INTERPRETER   DLM

                 1584 SCALE     1A FILTER      COLOR FILM

 INTERPRETED
  CONDITION                        ACTUAL
                                  CONDITION

                  UA       TRACE        MA          SA      COMMITTED     PI
                                                                        TOTALS
*****************************************************************************
            *
            *
  OMITTED   *   955.00      92.00      79.00      13.00                1139.00
            *
            *
  TRACE     *    74.00      11.00      18.00       1.00       1.00      105.00
            *
            *
  MA        *     7.00       2.00      10.00       6.00        .00       25.00
            *
            *
  SA        *     4.00        .00       2.00       2.00        .00        8.00
            *
            *
            *
 AFFECTED   *                13.00      30.00       9.00                  52.00
            *
            *
            *
*****************************************************************************
            *
  GROUND    *
  TOTALS    *  1040.00     105.00     109.00      22.00       1.00     1276.00
            *
```

NOT REPRODUCIBLE

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER BN

1584 SCALE 12 FILTER COL IR FILM

INTERPRETED CONDITION	ACTUAL CONDITION UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	927.00	85.00	68.00	12.00		1092.00
TRACE	74.00	11.00	18.00	3.00	1.00	107.00
MA	30.50	8.00	13.50	2.00	.00	54.00
SA	8.50	1.00	9.50	5.00	.00	24.00
AFFECTED		20.00	41.00	10.00		71.00
GROUND TOTALS	1040.00	105.00	109.00	22.00	1.00	1276.00

NOT REPRODUCIBLE

```
                      TVA AIR POLLUTION STUDY  1969

                           INTERPRETER    KN

                   1584 SCALE    12 FILTER    COL IR FILM

INTERPRETED                              ACTUAL
CONDITION                               CONDITION

                                                                     PI
                  UA        TRACE        MA         SA     COMMITTED TOTALS

******************************************************************************
             *
             *
   OMITTED   *   910.00     84.00      65.00      11.00              1070.00
             *
             *
   TRACE     *    77.00     14.00      13.50       2.00       2.00    108.50
             *
             *
   MA        *    39.00      5.00      19.50       2.00       3.00     68.50
             *
             *
   SA        *    14.00      2.00      11.00       7.00       3.00     37.00
             *
             *
             *
  AFFECTED   *              21.00      44.00      11.00                76.00
             *
             *
             *
******************************************************************************
             *
   GROUND    *
   TOTALS    *  1040.00    105.00     109.00      22.00       8.00   1276.00
             *
```

```
                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER   PNL

                  1584 SCALE    12 FILTER    COL IR FILM

INTERPRETED                               ACTUAL
 CONDITION                               CONDITION

                                                                  PI
                 UA        TRACE       MA         SA      COMMITTED  TOTALS

****************************************************************************
              *
              *
   OMIT'D     *   927.00     86.00      77.00      14.00             1104.00
              *
              *
    TRACE     *    93.00      8.00      24.00       3.00       .00    128.00
              *
              *
     MA       *    17.00     10.00       5.00       5.00      1.00     38.00
              *
              *
     SA       *     3.00      1.00       3.00        .00      1.00      8.00
              *
              *
              *
  AFFECTED    *              19.00      32.00       8.00               59.00
              *
              *
              *
****************************************************************************
              *
   GROUND     *
   TOTALS     *  1040.00    105.00     109.00      22.00      2.00   1276.00
              *
```

```
                        TVA AIR POLLUTION STUDY  1969

                             INTERPRETER   DLM

                   1584 SCALE    12 FILTER    COL IR FILM


  INTERPRETED                          ACTUAL
  CONDITION                            CONDITION

                                                                        PI
                   UA        TRACE       MA         SA      COMMITTED  TOTALS

*****************************************************************************
              *
              *
   OMIT'D     *   900.00     82.00      83.00      14.00              1079.00
              *
              *
   TRACE      *   132.00     22.00      24.00       5.00      2.00     185.00
              *
              *
   MA         *     8.00      1.00       1.00       3.00       .00      13.00
              *
              *
   SA         *      .00       .00       1.00        .00      1.00       2.00
              *
              *
              *
  AFFECTED    *              23.00      26.00       8.00                57.00
              *
              *
              *
*****************************************************************************
              *
   GROUND     *
   TOTALS     *  1040.00    105.00     109.00      22.00      3.00    1276.00
              *
```

NOT REPRODUCIBLE

```
                        TVA AIR POLLUTION STUDY  1969

                              INTERPRETER    BN

                      3960 SCALE     1A FILTER      COLOR FILM


 INTERPRETED                                 ACTUAL
 CONDITION                                   CONDITION

                                                                     PI
                     UA        TRACE        MA          SA     COMMITTED  TOTALS

*****************************************************************************
             *
             *
   OMIT'D    *     994.00      91.00      86.00       18.00         .    1189.00
             *
             *
   TRACE     *      36.00       9.00      14.00        1.00      .00      60.00
             *
             *
   MA        *      10.00       5.00       9.00        3.00      .00      27.00
             *
             *
   SA        *        .00        .00        .00         .00      .00        .00
             *
             *
             *
  AFFECTED   *          .      14.00      23.00        4.00               41.00
             *
             *
             *
*****************************************************************************
             *
  GROUND     *
  TOTALS     *    1040.00     105.00     109.00       22.00      .00    1276.00
             *
```

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER    KN

                    3960 SCALE    1A FILTER     COLOR FILM

INTERPRETED                           ACTUAL
CONDITION                            CONDITION

                                                                    RT
                      UA       TRACE       MA          SA     COMMITTED  TOTALS

*********************************************************************************
             *
             *
  OMITTD     *     978.00     90.00      60.00      14.00                1142.00
             *
             *
  TRACE      *      43.00      6.00      12.00       2.00       1.00       64.00
             *
             *
  MA         *      15.00      7.00      11.00       3.00        .00       36.00
             *
             *
  SA         *       4.00      2.00       6.00       3.00       1.00       16.00
             *
             *
             *
  AFFECTED   *                15.00      23.00       4.00                  42.00
             *
             *
             *
*********************************************************************************
             *
  GROUND     *
  TOTALS     *    1040.00    105.00     104.00      22.00       2.00     1274.00
             *
```

NOT REPRODUCIBLE

```
                  TVA AIR POLLUTION STUDY  1969

                        INTERPRETER   PM

            3960 SCALE     1A FILTER      COLOR FILM

INTERPRETED                        ACTUAL
 CONDITION                        CONDITION
                                                                IT
              UA       TRACE       MA         SA      COMMITTED  TOTALS
***************************************************************************
          *
          *
 OMITTED  *   993.00     97.00      88.00      14.00               1192.00
          *
          *
  TRACE   *    40.00      4.00      11.00       4.00       1.00      60.00
          *
          *
   MA     *     7.00      3.00       8.00       3.00       1.00      22.00
          *
          *
   SA     *      .00      1.00       2.00       1.00        .00       4.00
          *
          *
          *
 AFFECTED *               8.00      21.00       8.00                 37.00
          *
          *
          *
***************************************************************************
          *
 GROUND   *
 TOTALS   *  1040.00    105.00     109.00      22.00       2.00    1276.00
          *
```

NOT REPRODUCIBLE

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER   DLM

                   3960 SCALE     1A FILTER      COLOR FILM

 INTERPRETED                         ACTUAL
 CONDITION                          CONDITION
                                                                      BY
                   UA        TRACE        MA          SA       COMMITTED  TOTALS

**************************************************************************************
             *
             *
   OMITTED   *   1014.00      98.00      100.00      18.00                1230.00
             *
             *
   TRACE     *     26.00       7.00        8.00       4.00         .00      45.00
             *
             *
   MA        *       .00        .00        1.00        .00         .00       1.00
             *
             *
   SA        *       .00        .00         .00        .00         .00        .00
             *
             *
             *
  AFFECTED   *                 7.00        9.00       4.00                  20.00
             *
             *
             *
**************************************************************************************
             *
   GROUND    *
   TOTALS    *   1040.00     105.00      109.00      22.00         .00    1276.00
             *
```

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                         INTERPRETER    BN

                   3960 SCALE    12 FILTER    COL IR FILM

INTERPRETED                            ACTUAL
CONDITION                             CONDITION
                                                                    PI
                UA       TRACE       MA        SA     COMMITTED  TOTALS

*****************************************************************
          *
          *
 OMIT'D   *   1014.00     93.00     83.00     15.00              1205.00
          *
          *
 TRACE    *     17.00      9.00     17.00      2.00       .00      45.00
          *
          *
 MA       *      8.00      3.00      8.00      4.00       .00      23.00
          *
          *
 SA       *      1.00       .00      1.00      1.00       .00       3.00
          *
          *
          *
AFFECTED  *               12.00     26.00      7.00                45.00
          *
          *
          *
*****************************************************************
          *
 GROUND   *
 TOTALS   *   1040.00    105.00    109.00     22.00       .00    1276.00
          *
```

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER    KH

                     3960 SCALE     12 FILTER     COL IR FILM

INTERPRETED                            ACTUAL
 CONDITION                            CONDITION
                                                                        PI
                    UA         TRACE        MA          SA      COMMITTED  TOTALS

****************************************************************************
              *
              *
   OMITTED    *   961.00       84.00       78.00       16.00                1139.00
              *
              *
   TRACE      *    43.00       10.00       15.00        3.00       1.00       72.00
              *
              *
   MA         *    25.00        9.00        9.00        1.00        .00       44.00
              *
              *
   SA         *    11.00        2.00        7.00        2.00        .00       22.00
              *
              *
              *
  AFFECTED    *                21.00       31.00        6.00                  58.00
              *
              *
              *
****************************************************************************
              *
   GROUND     *
   TOTALS     *  1040.00      105.00      108.00       22.00       1.00     1276.00
              *
```

NOT REPRODUCIBLE

```
                         TVA AIR POLLUTION STUDY  1969

                               INTERPRETER   RML

                      3960 SCALE    12 FILTER    COL IR FILM

    INTERPRETED                             ACTUAL
    CONDITION                              CONDITION
                                                                        IT
                    UA       TRACE       MA        SA     COMMITTED   TOTALS

*******************************************************************************
               *
               *
      OMITTED  *   989.00     94.00     93.00     17.00             1193.00
               *
               *
       TRACE   *    41.50      5.00     10.50      3.00       .00     60.00
               *
               *
        MA     *     9.50      6.00      5.00      2.00       .00     22.50
               *
               *
        SA     *      .00       .00       .50       .00       .00       .50
               *
               *
               *
     AFFECTED  *               11.00     16.00      5.00              32.00
               *
               *
               *
*******************************************************************************
               *
      GROUND   *
      TOTALS   *  1040.00    105.00    109.00     22.00       .00   1276.00
               *
```

NOT REPRODUCIBLE

```
                          TVA AIR POLLUTION STUDY  1969

                                INTERPRETER   DLM

                        3960 SCALE      12 FILTER     COL IR FILM


     INTERPRETED                             ACTUAL
     CONDITION                              CONDITION

                         UA        TRACE        MA         SA      COMMITTED    PI
                                                                               TOTALS
*************************************************************************************
                  *
                  *
       OMITTED    *     992.00     95.00      98.00      19.00                1204.00
                  *
                  *
       TRACE      *      47.00     10.00      10.00       3.00      1.00        71.00
                  *
                  *
       MA         *       1.00       .00       1.00        .00       .00         2.00
                  *
                  *
       SA         *        .00       .00        .00        .00       .00          .00
                  *
                  *
                  *
       AFFECTED   *                10.00      11.00       3.00                  24.00
                  *
                  *
                  *
*************************************************************************************
                  *
       GROUND     *
       TOTALS     *    1040.00    105.00     109.00      22.00      1.00      1276.00
                  *
```

NOT REPRODUCIBLE

```
                     TVA AIR POLLUTION STUDY  1969

                          INTERPRETER    RN

               7920 SCALE     1A FILTER      COLOR FILM


 INTERPRETED                         ACTUAL
  CONDITION                         CONDITION
                                                                     PI
                    UA       TRACE        MA        SA    COMMITTED  TOTALS

*****************************************************************************
             *
             *
   OMITTED   *   1019.00     98.00    104.00     21.00              1242.00
             *
             *
   TRACE     *     18.00      5.00      2.00      1.00       .00      26.00
             *
             *
   MA        *      3.00      1.00      3.00       .00       .00       7.00
             *
             *
   SA        *       .00      1.00       .00       .00       .00       1.00
             *
             *
             *
   AFFECTED  *                7.00      5.00      1.00                13.00
             *
             *
             *
*****************************************************************************
             *
   GROUND    *
   TOTALS    *   1040.00    105.00    109.00     22.00       .00    1276.00
             *
```

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER KN

7920 SCALE 1A FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	OI TOTALS
OMITTED	1021.00	100.00	92.00	15.00		1228.00
TRACE	4.00	1.00	1.00	1.00	.00	7.00
MA	12.00	3.00	9.00	4.00	.00	28.00
SA	3.00	1.00	7.00	2.00	.00	13.00
AFFECTED		5.00	17.00	7.00		29.00
GROUND TOTALS	1040.00	105.00	109.00	22.00	.00	1276.00

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER   RNL

                 7920 SCALE     1A FILTER     COLOR FILM


INTERPRETED                            ACTUAL
CONDITION                              CONDITION
                                                                 PI
                    UA       TRACE       MA        SA    COMMITTED  TOTALS

***************************************************************************
              *
              *
   OMIT'D     *  1010.00    103.00     98.00     19.00              1230.00
              *
              *
   TRACE      *    26.00      2.00      9.00      2.00       .00      39.00
              *
              *
   MA         *     4.00       .00      2.00      1.00       .00       7.00
              *
              *
   SA         *      .00       .00       .00       .00       .00        .00
              *
              *
              *
  AFFECTED    *               2.00     11.00      3.00                16.00
              *
              *
              *
***************************************************************************
              *
  GROUND      *
  TOTALS      *  1040.00    105.00    109.00     22.00       .00    1276.00
              *
```

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER   DLM

                  7920 SCALE     1A FILTER     COLOR FILM


INTERPRETED                              ACTUAL
 CONDITION                              CONDITION

                                                                          RT
                   UA        TRACE        MA          SA      COMMITTED  TOTALS

****************************************************************************
            *
            *
   OMIT'D   *   1028.00      95.00     104.00      18.00                1245.00
            *
            *
   TRACE    *     12.00       9.00       5.00       4.00        .00      30.00
            *
            *
    MA      *       .00       1.00        .00        .00        .00       1.00
            *
            *
    SA      *       .00        .00        .00        .00        .00        .00
            *
            *
            *
 AFFECTED   *                10.00       5.00       4.00                 19.00
            *
            *
            *
****************************************************************************
            *
  GROUND    *
  TOTALS    *   1040.00     105.00     109.00      22.00        .00    1276.00
            *
```

NOT REPRODUCIBLE

NOT REPRODUCIBLE

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER    BN

                       7920 SCALE    12 FILTER    COL 12 FILM

 INTERPRETED                          ACTUAL
 CONDITION                            CONDITION
                                                                    PI
                UA        TRACE       MA         SA       COMMITTED  TOTALS

*********************************************************************************
             *
             *
   OMIT'D    *  1024.00    102.00     103.00      19.00               1248.00
             *
             *
   TRACE     *     9.00      1.00       4.00       1.00        .00      15.00
             *
             *
   MA        *     2.00      2.00       1.00        .00        .00       5.00
             *
             *
   SA        *     5.00       .00       1.00       2.00        .00       8.00
             *
             *
             *
  AFFECTED   *               3.00       6.00       3.00                 12.00
             *
             *
             *
*********************************************************************************
             *
   GROUND    *
   TOTALS    *  1040.00    105.00     109.00      22.00        .00    1276.00
             *
```

TVA AIR POLLUTION STUDY 1969

INTERPRETER KN

7920 SCALE 12 FILTER COL IR FILM

INTERPRETED CONDITION	ACTUAL CONDITION UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	1014.00	98.00	94.00	14.00		1220.00
TRACE	9.00	2.00	1.00	.00	.00	12.00
MA	14.00	5.00	8.00	4.00	1.00	32.00
SA	3.00	.00	6.00	4.00	.00	13.00
AFFECTED		7.00	15.00	8.00		30.00
GROUND TOTALS	1040.00	105.00	109.00	22.00	1.00	1276.00

NOT REPRODUCIBLE

TVA-AIR POLLUTION STUDY 1969

INTERPRETER DNI

7920 SCALE 12 FILTER COL IR FILM

INTERPRETED CONDITION	ACTUAL CONDITION UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	1001.00	99.00	102.00	19.00		1221.00
TRACE	37.00	6.00	4.00	1.00	.00	48.00
MA	.00	.00	2.00	2.00	.00	4.00
SA	2.00	.00	1.00	.00	.00	3.00
AFFECTED		6.00	7.00	3.00		16.00
GROUND TOTALS	1040.00	105.00	109.00	22.00	.00	1276.00

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                         INTERPRETER   DLM

                 7920 SCALE     12 FILTER     COL IR FILM

INTERPRETED                            ACTUAL
CONDITION                             CONDITION

                                                                    PI
                  UA       TRACE        MA         SA    COMMITTED  TOTALS

***************************************************************************
             *
             *
   OMIT'D    *  1035.00    104.00     105.00      22.00             1266.00
             *
             *
   TRACE     *     5.00      1.00       3.00        .00      1.00     10.00
             *
             *
   MA        *      .00       .00        .00        .00       .00       .00
             *
             *
   SA        *      .00       .00       1.00        .00       .00      1.00
             *
             *
             *
  AFFECTED   *               1.00       4.00        .00                5.00
             *
             *
             *
***************************************************************************
             *
   GROUND    *
   TOTALS    *  1040.00    105.00     109.00      22.00      1.00   1276.00
             *
```

NOT REPRODUCIBLE

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                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER   RM

              1584 SCALE      D FILTER      COLOR FILM


INTERPRETED                           ACTUAL
 SPECIES                              SPECIES

                                                                   PI
                LP         VP         SP         HDW   COMMITTED  TOTALS

*****************************************************************************
             *
   LP        *  33.00        .00        .00       1.00       .00    34.00
             *
   VP        *    .00       1.00        .00        .00       .00     1.00
             *
   SP        *    .00        .00       4.00       1.00       .00     5.00
             *
   HDW       *   1.00        .00       4.00      11.00       .00    16.00
             *
 AFFECTED    *
 & OMIT'D    *  87.00      17.00      36.00      30.00             170.00
             *
             *
*****************************************************************************
             *
  GROUND     *
  TOTAL      *  121.00     18.00      44.00      43.00             226.00
 AFFECTED    *
             *
  GROUND     *
  TOTALS     *  411.00     48.00      55.00     259.00       .00   773.00
             *
```

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER KN

1584 SCALE D FILTER COLOR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	44.00	.50	1.00	1.00	1.00	47.50
VP	.00	3.50	.00	.00	.00	3.50
SP	6.00	1.00	23.00	.00	.00	30.00
HDW	2.00	.00	5.00	12.00	1.00	20.00
AFFECTED & OMITT'D	69.00	13.00	15.00	30.00		127.00
GROUND TOTAL AFFECTED	121.00	18.00	44.00	43.00		226.00
GROUND TOTALS	411.00	46.00	55.00	259.00	2.00	773.00

NOT REPRODUCIBLE

```
                          TVA AIR POLLUTION STUDY  1969

                               INTERPRETER   PNI

                    1584 SCALE      D FILTER      COLOR FILM


   INTERPRETED                             ACTUAL
    SPECIES                                SPECIES
                                                                           PI
                      LP         VP         SP         HDW    COMMITTED  TOTALS

*************************************************************************************
              *
              *
      LP      *     23.00       1.00      22.00       4.00       1.00      51.00
              *
              *
      VP      *      1.00       4.00       3.00        .00        .00       8.00
              *
              *
      SP      *      2.00        .00       2.00        .00        .00       4.00
              *
              *
      HDW     *      1.00        .00       2.00       4.00        .00       7.00
              *
   AFFECTED   *
   & OMIT'D   *     94.00      13.00      15.00      35.00                157.00
              *
              *
*************************************************************************************
              *
    GROUND    *
    TOTAL     *    121.00      18.00      44.00      43.00                226.00
   AFFECTED   *
              *
    GROUND    *
    TOTALS    *    411.00      48.00      55.00     259.00       1.00     773.00
              *
```

NOT REPRODUCIBLE

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETED   DLM

                     1584 SCALE      D FILTER      COLOR FILM


   INTERPRETED                         ACTUAL
   SPECIES                             SPECIES

                                                                         PI
                       LP        VP        SP        HDW    COMMITTED  TOTALS

****************************************************************************
                *
                *
      LP        *    22.00      1.00     16.00       .00       .00      39.00
                *
                *
      VP        *     1.00      1.00      2.00       .00       .00       4.00
                *
                *
      SP        *      .00      2.00      4.00       .00       .00       6.00
                *
                *
      HDW       *      .00       .00      2.00     10.00       .00      12.00
                *
    AFFECTED    *
    & OMITTED   *    98.00     14.00     20.00     33.00               165.00
                *
                *
****************************************************************************
                *
     GROUND     *
     TOTAL      *   121.00     18.00     44.00     43.00               226.00
    AFFECTED    *
                *
     GROUND     *
     TOTALS     *   411.00     48.00     55.00    259.00       .00     773.00
                *
```

NOT REPRODUCIBLE

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                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER    RN

                       1584 SCALE     1A FILTER     COLOR FILM


 INTERPRETED                               ACTUAL
  SPECIES                                  SPECIES

                                                                          PI
                    LP        VP        SP        HDW    COMMITTED   TOTALS

********************************************************************************
              *
              *
    LP        *    31.00       .00       .00       .00       .00      31.00
              *
              *
    VP        *      .00      3.00       .00       .00       .00       3.00
              *
              *
    SP        *     2.00       .00     14.00       .00       .00      16.00
              *
              *
    HDW       *     2.00       .00      3.00     21.00      1.00      27.00
              *
 AFFECTED     *
 & OMITTED    *    89.00     15.00     27.00     29.00               160.00
              *
              *
********************************************************************************
              *
  GROUND      *
  TOTAL       *   124.00     18.00     44.00     50.00               236.00
 AFFECTED     *
              *
  GROUND      *
  TOTALS      *   684.00     62.00    131.00    396.00      1.00    1274.00
              *
```

NOT REPRODUCIBLE

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                              TVA AIR POLLUTION STUDY  1969

                                 INTERPRETER    KN

                          1584 SCALE    1A FILTER     COLOR FILM


INTERPRETED                                 ACTUAL
  SPECIES                                   SPECIES

                                                                            PT
                   LP         VP         SP         HOW      COMMITTED   TOTALS

***********************************************************************************
            *
            *
    LP      *    40.00      1.00        .00        .00       1.00       42.00
            *
            *
    VP      *      .00      1.00        .00        .00       1.00        2.00
            *
            *
    SP      *     3.00      4.00       7.00        .00       2.00       16.00
            *
            *
    HOW     *     1.00      1.00        .00      10.00       4.00       16.00
            *
  AFFECTED  *
  & OMITTED *    80.00     11.00      37.00      40.00                 168.00
            *
            *
***********************************************************************************
            *
   GROUND   *
   TOTAL    *   124.00     18.00      44.00      50.00                 236.00
  AFFECTED  *
            *
   GROUND   *
   TOTALS   *   688.00     62.00     131.00     385.00       8.00     1274.00
            *
```

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER PHI

1584 SCALE 1A FILTER COLOR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HOW	COMMITTED	DI TOTALS
LP	18.00	.00	13.00	.00	3.00	34.00
VP	1.00	4.00	4.00	.00	.00	9.00
SP	1.00	.00	8.00	.00	.00	9.00
HOW	.00	.00	1.00	7.00	.00	8.00
AFFECTED & OMITT.D	104.00	14.00	18.00	43.00		179.00
GROUND TOTAL AFFECTED	124.00	18.00	44.00	50.00		236.00
GROUND TOTALS	688.00	62.00	131.00	395.00	3.00	1276.00

NOT REPRODUCIBLE

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                    TVA AIR POLLUTION STUDY  1969

                         INTERPRETER   PLM

              1584 SCALE     1A FILTER      COLOR FILM


 INTERPRETED                        ACTUAL
   SPECIES                          SPECIES

                                                               PI
                 LP        VP        SP        HOW   COMMITTED TOTALS

**********************************************************************
            *
            *
    LP      *   20.00      .00      5.00      .00      .00     25.00
            *
            *
    VP      *     .00     4.00      2.00      .00      .00      6.00
            *
            *
    SP      *    1.00      .00      1.00      .00      .00      2.00
            *
            *
    HOW     *    2.00      .00       .00    17.00     1.00     20.00
            *
  AFFECTED  *
  & OMITTED *  101.00    14.00     36.00    33.00             184.00
            *
            *
**********************************************************************
            *
  GROUND    *
  TOTAL     *  124.00    18.00     44.00    50.00             236.00
  AFFECTED  *
            *
  GROUND    *
  TOTALS    *  688.00    62.00    131.00   395.00     1.00   1276.00
            *
```

NOT REPRODUCIBLE

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER    RN

                    1584 SCALE    12 FILTER    COL IR FILM


 INTERPRETED                          ACTUAL
   SPECIES                            SPECIES
                                                                    PI
                 LP         VP         SP         HOW    COMMITTED  TOTALS

*******************************************************************************
            *
            *
    LP      *    34.00        .00        .00        .00        .00     34.00
            *
            *
    VP      *      .00       5.00        .00        .00        .00      5.00
            *
            *
    SP      *     1.00        .00      12.00        .00        .00     13.00
            *
            *
   HOW      *     2.00        .00       2.00      15.00       1.00     20.00
            *
 AFFECTED   *
 & OMIT'D   *    87.00      13.00      30.00      35.00               165.00
            *
            *
*******************************************************************************
            *
  GROUND    *
  TOTAL     *   124.00      18.00      44.00      50.00               236.00
 AFFECTED   *
            *
  GROUND    *
  TOTALS    *   688.00      62.00     131.00     394.00       1.00   1276.00
            *
```

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                         INTERPRETER    KN

                  1584 SCALE    12 FILTER    COL IR FILM


INTERPRETED                        ACTUAL
  SPECIES                          SPECIES

                 LP        VP        SP        HDW     COMMITTED   PI
                                                                  TOTALS

**********************************************************************
             *
             *
    LP       *   36.50       .50      3.00       .50      2.00     42.50
             *
             *
    VP       *     .00      6.50      1.00       .00       .00      7.50
             *
             *
    SP       *     .00       .00     10.50      1.00       .00     11.50
             *
             *
    HDW      *     .50       .00      2.50     13.50      6.00     22.50
             *
  AFFECTED   *
  & OMIT'D   *   87.00     11.00     27.00     35.00               160.00
             *
             *
**********************************************************************
             *
   GROUND    *
   TOTAL     *  124.00     18.00     44.00     50.00               236.00
  AFFECTED   *
             *
   GROUND    *
   TOTALS    *  688.00     62.00    131.00    385.00      8.00   1274.00
             *
```

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER   DNI

                    1584 SCALE    12 FILTER    COL IR FILM

INTERPRETED                                  ACTUAL
  SPECIES                                    SPECIES
                                                                        BY
                  LP         VP         SP         HDW      COMMITTED  TOTALS

*******************************************************************************
                 *
                 *
     LP          *      21.00        .00       8.00       2.00       2.00      33.00
                 *
                 *
     VP          *        .00       4.00       4.00        .00        .00       8.00
                 *
                 *
     SP          *        .00        .00       5.00        .00        .00       5.00
                 *
                 *
     HDW         *        .00        .00        .00      15.00        .00      15.00
                 *
  AFFECTED       *
  & OMITTED      *     103.00      14.00      27.00      33.00                177.00
                 *
                 *
*******************************************************************************
                 *
   GROUND        *
   TOTAL         *     124.00      18.00      44.00      50.00                236.00
  AFFECTED       *
                 *
   GROUND        *
   TOTALS        *     688.00      62.00     131.00     395.00       2.00    1276.00
                 *
```

NOT REPRODUCIBLE

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                                   TVA AIR POLLUTION STUDY  1969

                                       INTERPRETER   DLM

                                 1584 SCALE     12 FILTER     COL IR FILM


            INTERPRETED                                     ACTUAL
              SPECIES                                       SPECIES

                                                                                         PI
                                   LP          VP          SP          HDW      COMMITTED  TOTALS

            ******************************************************************************************
                             *
                             *
                LP           *    27.00         .00        3.00         .00        3.00     33.00
                             *
                             *
                VP           *      .00         .00         .00         .00         .00       .00
                             *
                             *
                SP           *     1.00        3.00         .00         .00         .00      4.00
                             *
                             *
                HDW          *     3.00         .00        1.00       19.00         .00     23.00
                             *
             AFFECTED        *
             & OMIT'D        *    93.00       15.00       40.00       31.00                179.00
                             *
                             *
            ******************************************************************************************
                             *
              GROUND         *
              TOTAL          *   124.00       18.00       44.00       50.00                236.00
             AFFECTED        *
                             *
              GROUND         *
              TOTALS         *   688.00       62.00      131.00      395.00        3.00   1276.00
                             *
```

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER SM

3960 SCALE 1A FILTER COLOR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	18.00	.00	.00	1.00	.00	19.00
VP	.00	1.00	.00	.00	.00	1.00
SP	1.00	.00	9.00	1.00	.00	11.00
HDW	1.00	.00	5.00	4.00	.00	10.00
AFFECTED & OMIT'D	104.00	17.00	30.00	44.00		195.00
GROUND TOTAL AFFECTED	124.00	18.00	44.00	50.00		236.00
GROUND TOTALS	684.00	62.00	131.00	399.00	.00	1276.00

NOT REPRODUCIBLE

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                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER    KN

                         3960 SCALE    1A FILTER     COLOR FILM

 INTERPRETED                                   ACTUAL
   SPECIES                                     SPECIES

                      LP         VP         SP          HDW    COMMITTED    PI
                                                                          TOTALS
*******************************************************************************
                *
                *
      LP        *   25.00       .00       6.00         .00       1.00     32.00
                *
                *
      VP        *    3.00      6.00        .00         .00        .00      9.00
                *
                *
      SP        *     .00       .00        .00         .00        .00       .00
                *
                *
      HDW       *    3.00       .00       3.00        6.00       1.00     13.00
                *
   AFFECTED     *
   & OMITTED    *   93.00     12.00      35.00       44.00                184.00
                *
                *
*******************************************************************************
                *
    GROUND      *
    TOTAL       *  124.00     18.00      44.00       50.00                236.00
   AFFECTED     *
                *
    GROUND      *
    TOTALS      *  688.00     62.00     131.00      393.00       2.00    1276.00
                *
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NOT REPRODUCIBLE

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                    TVA AIR POLLUTION STUDY  1969

                         INTERPRETER   DNL

              3960 SCALE     1A FILTER      COLOR FILM


   INTERPRETED                        ACTUAL
     SPECIES                          SPECIES
                                                                      RI
                  LP         VP         SP         HDW     COMMITTED  TOTALS

****************************************************************************
              *
              *
      LP      *  10.00       .00       14.00       1.00       2.00     27.00
              *
              *
      VP      *   3.00      3.00        .00         .00        .00      6.00
              *
              *
      SP      *    .00       .00        .00         .00        .00       .00
              *
              *
      HDW     *   1.00       .00       3.00        2.00        .00      6.00
              *
    AFFECTED  *
    & OMIT'D  * 110.00     15.00      27.00       47.00               199.00
              *
              *
****************************************************************************
              *
     GROUND   *
     TOTAL    * 124.00     18.00      44.00       50.00               236.00
    AFFECTED  *
              *
     GROUND   *
     TOTALS   * 688.00     62.00     131.00      395.00       2.00   1276.00
              *
```

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER DLM

3960 SCALE   1A FILTER   COLOR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	RT TOTALS
LP	10.00	.00	2.00	.00	.00	12.00
VP	.00	3.00	.00	.00	.00	3.00
SP	.00	.00	.00	.00	.00	.00
HDW	.00	.00	2.00	3.00	.00	5.00
AFFECTED & OMIT'D	114.00	15.00	40.00	47.00		216.00
GROUND TOTAL AFFECTED	124.00	18.00	44.00	50.00		236.00
GROUND TOTALS	689.00	62.00	131.00	395.00	.00	1276.00

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER RN

3960 SCALE 12 FILTER COL IR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HOW	COMMITTED	PI TOTALS
LP	17.00	.00	.00	.00	.00	17.00
VP	.00	3.00	.00	.00	.00	3.00
SP	2.00	.00	7.00	1.00	.00	10.00
HOW	1.00	.00	8.00	6.00	.00	15.00
AFFECTED & OMIT'D	104.00	15.00	29.00	43.00		191.00
GROUND TOTAL AFFECTED	124.00	18.00	44.00	50.00		236.00
GROUND TOTALS	688.00	62.00	131.00	395.00	.00	1276.00

NOT REPRODUCIBLE

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                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETED    KN

                      3960 SCALE     12 FILTER     COL IR FILM


INTERPRETED                                     ACTUAL
  SPECIES                                       SPECIES

                      LP        VP        SP        HDW     COMMITTED  TOTALS

**************************************************************************************
               *
               *
   LP          *    35.00       .00      9.00      2.00      1.00      47.00
               *
               *
   VP          *      .00      3.00       .00       .00       .00       3.00
               *
               *
   SP          *      .00       .00       .00       .00       .00        .00
               *
               *
   HDW         *      .00      1.00      2.00      4.00       .00       7.00
               *
 AFFECTED      *
 & OMITTED     *    89.00     14.00     33.00     42.00               178.00
               *
               *
**************************************************************************************
               *
  GROUND       *
  TOTAL        *   124.00     18.00     44.00     48.00               234.00
 AFFECTED      *
               *
  GROUND       *
  TOTALS       *   688.00     62.00    131.00  [illegible]   1.00  [illegible]
               *
```

NOT REPRODUCIBLE

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                       TVA AIR POLLUTION STUDY  1969

                            INTERPRETER   RHI

                   3960 SCALE     12 FILTER     COL IR FILM


   INTERPRETED                             ACTUAL
     SPECIES                               SPECIES

                                                                    RT
                      LP        VP        SP        HOW     COMMITTED  TOTALS

 ****************************************************************************
                 *
                 *
       LP        *   13.00      1.00      4.00      .00       .00     18.00
                 *
                 *
       VP        *    1.00      2.00       .00      .00       .00      3.00
                 *
                 *
       SP        *     .00       .00      1.00      .00       .00      1.00
                 *
                 *
       HOW       *    2.00       .00      8.00      .00       .00     10.00
                 *
    AFFECTED     *
    & OMITTED    *  108.00     15.00     31.00    50.00              204.00
                 *
                 *
 ****************************************************************************
                 *
     GROUND      *
     TOTAL       *  124.00     18.00     44.00    50.00              236.00
    AFFECTED     *
                 *
     GROUND      *
     TOTALS      *  688.00     62.00    131.00   395.00       .00   1276.00
                 *
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NOT REPRODUCIBLE

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                        TVA AIR POLLUTION STUDY  1969

                              INTERPRETER   DLM

                      3960 SCALE     12 FILTER     COL IR FILM


 INTERPRETED                                ACTUAL
  SPECIES                                   SPECIES

                    LP        VP        SP        HOW     COMMITTED    RT
                                                                      TOTALS
****************************************************************************
               *
               *
     LP        *    13.00       .00       .00      1.00       .00      14.00
               *
               *
     VP        *      .00      3.00       .00       .00       .00       3.00
               *
               *
     SP        *      .00       .00       .00       .00       .00        .00
               *
               *
     HOW       *     2.00       .00      3.00      2.00      1.00       8.00
               *
   AFFECTED    *
   & OMITTED   *   109.00     15.00     41.00     47.00               212.00
               *
               *
****************************************************************************
               *
    GROUND     *
    TOTAL      *   124.00     18.00     44.00     50.00               236.00
   AFFECTED    *
               *
    GROUND     *
    TOTALS     *   688.00     62.00    131.00    394.00      1.00    1276.00
               *
```

NOT REPRODUCIBLE

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                    TVA AIR POLLUTION STUDY  1969

                          INTERPRETER    [illegible]

                   7920 SCALE     1A FILTER     COLOR FILM


INTERPRETED                             ACTUAL
  SPECIES                               SPECIES

                                                                        [illegible]
                        LP          VP          SP          HDW     COMMITTED  TOTALS

******************************************************************************
               *
               *
    LP         *       8.00         .00         .00         .00         .00       8.00
               *
               *
    VP         *        .00         .00         .00         .00         .00        .00
               *
               *
    SP         *        .00         .00        1.00        1.00         .00       2.00
               *
               *
    HDW        *       1.00         .00         .00        2.00         .00       3.00
               *
 AFFECTED      *
 & OMITTED     *     115.00       18.00       43.00       47.00                 223.00
               *
               *
******************************************************************************
               *
  GROUND       *
  TOTAL        *     124.00       18.00       44.00       50.00                 236.00
 AFFECTED      *
               *
  GROUND       *
  TOTALS       *     688.00       62.00      131.00      395.00         .00    1276.00
               *
```

NOT REPRODUCIBLE

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER    KN

                     7920 SCALE     1A FILTER     COLOR FILM


 INTERPRETED                                  ACTUAL
   SPECIES                                    SPECIES

                                                                          DI
                         LP         VP         SP         HOW     COMMITTED  TOTALS

******************************************************************************
                 *
                 *
      LP         *      8.00       2.00       9.00        .00        .00      19.00
                 *
                 *
      VP         *      1.00       2.00        .00        .00        .00       3.00
                 *
                 *
      SP         *       .00        .00        .00        .00        .00        .00
                 *
                 *
      HOW        *      1.00        .00       4.00       2.00        .00       7.00
                 *
   AFFECTED      *
   & OMITTED     *    114.00      14.00      31.00      48.00                 207.00
                 *
                 *
******************************************************************************
                 *
    GROUND       *
    TOTAL        *    124.00      18.00      44.00      50.00                 236.00
   AFFECTED      *
                 *
    GROUND       *
    TOTALS       *    688.00      62.00     131.00     395.00        .00    1276.00
                 *
```

NOT REPRODUCIBLE

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER   RNL

                   7920 SCALE     1A FILTER      COLOR FILM


 INTERPRETED                               ACTUAL
   SPECIES                                 SPECIES

                                                                      BY
                  LP         VP         SP          HDW    COMMITTED  TOTALS

****************************************************************************
              *
              *
    LP        *    7.00       1.00       4.00        .00        .00      12.00
              *
              *
    VP        *    1.00       1.00        .00        .00        .00       2.00
              *
              *
    SP        *     .00        .00        .00        .00        .00        .00
              *
              *
    HDW       *    2.00        .00        .00        .00        .00       2.00
              *
  AFFECTED    *
  & OMIT'D    *  114.00      16.00      40.00      50.00                220.00
              *
              *
****************************************************************************
              *
   GROUND     *
   TOTAL      *  124.00      18.00      44.00      50.00                236.00
  AFFECTED    *
              *
   GROUND     *
   TOTALS     *  688.00      62.00     131.00     395.00        .00    1276.00
              *
```

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                         INTERPRETER   DLM

               7920 SCALE     1A FILTER      COLOR FILM


  INTERPRETED                           ACTUAL
    SPECIES                             SPECIES

                                                                     PI
                   LP          VP          SP          HDW     COMMITTED  TOTALS

********************************************************************************
               *
               *
      LP       *     10.00        1.00        2.00        .00        .00      13.00
               *
               *
      VP       *       .00        1.00         .00        .00        .00       1.00
               *
               *
      SP       *       .00         .00         .00        .00        .00        .00
               *
               *
      HDW      *      1.00         .00        4.00        .00        .00       5.00
               *
   AFFECTED    *
   & OMIT'D    *    113.00       16.00       38.00      50.00                217.00
               *
               *
********************************************************************************
               *
    GROUND     *
    TOTAL      *    124.00       18.00       44.00      50.00                236.00
   AFFECTED    *
               *
    GROUND     *
    TOTALS     *    688.00       62.00      131.00     395.00        .00    1276.00
               *
```

NOT REPRODUCIBLE

```
                         TVA AIR POLLUTION STUDY  1969

                              INTERPRETER    RN

                      7920 SCALE    12 FILTER    COL IR FILM


  INTERPRETED                          ACTUAL
    SPECIES                            SPECIES

                                                                          BY
                     LP          VP          SP          HOW     COMMITTED   TOTALS

***************************************************************************************
             *
             *
     LP      *      5.00        1.00         .00         .00        .00        6.00
             *
             *
     VP      *       .00         .00         .00         .00        .00         .00
             *
             *
     SP      *      1.00         .00        1.00         .00        .00        2.00
             *
             *
     HOW     *       .00         .00         .00        4.00        .00        4.00
             *
   AFFECTED  *
   & OMIT'D  *    118.00       17.00       43.00       46.00                  224.00
             *
             *
***************************************************************************************
             *
   GROUND    *
   TOTAL     *    124.00       18.00       44.00       50.00                  236.00
   AFFECTED  *
             *
   GROUND    *
   TOTALS    *    688.00       62.00      131.00      395.00        .00      1276.00
             *
```

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER KN

7920 SCALE 12 FILTER COL IR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	17.00	1.00	5.00	3.00	1.00	27.00
VP	.00	1.00	.00	.00	.00	1.00
SP	.00	.00	.00	.00	.00	.00
HDW	.00	.00	1.00	2.00	.00	3.00
AFFECTED & OMIT'D	107.00	16.00	38.00	45.00		206.00
GROUND TOTAL AFFECTED	124.00	18.00	44.00	50.00		236.00
GROUND TOTALS	688.00	62.00	131.00	392.00	1.00	1274.00

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1969

INTERPRETER RNL

7920 SCALE 12 FILTER COL IR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	9.00	.00	2.00	.00	.00	11.00
VP	1.00	.00	.00	.00	.00	1.00
SP	.00	.00	.00	.00	.00	.00
HDW	2.00	.00	.00	2.00	.00	4.00
AFFECTED & OMIT'D	112.00	18.00	42.00	45.00		220.00
GROUND TOTAL AFFECTED	124.00	18.00	44.00	50.00		236.00
GROUND TOTALS	688.00	62.00	131.00	395.00	.00	1276.00

NOT REPRODUCIBLE

```
                          TVA AIR POLLUTION STUDY  1969

                               INTERPRETER   DLM

                          7920 SCALE    12 FILTER    COL IR FILM


INTERPRETED                                   ACTUAL
  SPECIES                                     SPECIES

                                                                               BT
                       LP          VP          SP          HDW     COMMITTED   TOTALS
*********************************************************************************
              *
              *
     LP       *       2.00         .00        1.00         .00        1.00      4.00
              *
              *
     VP       *        .00         .00         .00         .00         .00       .00
              *
              *
     SP       *        .00         .00         .00         .00         .00       .00
              *
              *
     HDW      *        .00         .00         .00        2.00         .00      2.00
              *
  AFFECTED    *
  & OMITTED   *     122.00       18.00       43.00       48.00                 231.00
              *
              *
*********************************************************************************
              *
   GROUND     *
   TOTAL      *     124.00       18.00       44.00       50.00                 236.00
  AFFECTED    *
              *
   GROUND     *
   TOTALS     *     688.00       62.00      131.00      395.00        1.00    1276.00
              *
```

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1970

INTERPRETER RN

800 SCALE D FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	533.00	33.00	14.00	19.00		599.00
TRACE	30.00	16.00	5.50	.00	2.00	53.50
MA	57.00	28.00	21.50	15.00	6.00	127.50
SA	1.00	.00	5.00	19.00	1.00	26.00
AFFECTED		44.00	32.00	34.00		110.00
GROUND TOTALS	621.00	77.00	46.00	53.00	9.00	797.00

```
                         TVA AIR POLLUTION STUDY  1970

                              INTERPRETER  WAH

                      800  SCALE     D  FILTER    COLOR  FILM


 INTERPRETED                          ACTUAL
 CONDITION                           CONDITION

                                                                     PI
                    UA       TRACE       MA         SA     COMMITTED  TOTALS

************************************************************************
              *
              *
   OMIT'D     *   598.00     47.00     14.00       5.00               664.00
              *
              *
   TRACE      *    19.00     12.50      7.50       1.00       3.00     43.00
              *
              *
   MA         *     3.00     12.00     14.17       6.50       4.00     39.67
              *
              *
   SA         *     1.00      5.50     10.33      40.50      12.00     69.33
              *
              *
              *
  AFFECTED    *              30.00     32.00      48.00               110.00
              *
              *
              *
************************************************************************
              *
  GROUND      *
  TOTALS      *   621.00     77.00     46.00      53.00      19.00    797.00
              *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER RC

800 SCALE D FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	616.00	64.00	19.00	10.00		709.00
TRACE	4.00	7.00	12.50	3.50	.00	27.00
MA	.00	5.00	8.00	7.50	4.00	24.50
SA	1.00	1.00	6.50	32.00	9.00	49.50
AFFECTED		13.00	27.00	43.00		83.00
GROUND TOTALS	621.00	77.00	46.00	53.00	13.00	797.00

```
                    TVA AIR POLLUTION STUDY  1970

                         INTERPRETER  DLM

                  800  SCALE     D  FILTER    COLOR  FILM

INTERPRETED
CONDITION                          ACTUAL
                                  CONDITION
                                                                    PI
                 UA       TRACE       MA         SA     COMMITTED  TOTALS
***************************************************************************
              *
              *
   OMIT'D     *  611.00     56.00     18.00     12.00               697.00
              *
              *
   TRACE      *    9.00     19.50     18.75      5.00      4.00      56.25
              *
              *
   MA         *    1.00      1.50      3.25     11.00      1.00      17.75
              *
              *
   SA         *     .00       .00      6.00     25.00      2.00      33.00
              *
              *
              *
  AFFECTED    *             21.00     28.00     41.00                90.00
              *
              *
              *
***************************************************************************
              *
   GROUND     *
   TOTALS     *  621.00     77.00     46.00     53.00      7.00     797.00
              *
```

```
                        TVA AIR POLLUTION STUDY  1970

                             INTERPRETER   RN

                   800  SCALE    12  FILTER    IR COL FILM


  INTERPRETED                              ACTUAL
  CONDITION                              CONDITION

                                                                   PI
                     UA      TRACE       MA        SA   COMMITTED TOTALS

*****************************************************************************
             *
             *
   OMIT'D    *    553.00     46.00     19.00     14.00            632.00
             *
             *
   TRACE     *     19.00      9.00       .00       .00       .00   28.00
             *
             *
   MA        *     48.00     22.00     18.00      9.50      3.00  100.50
             *
             *
   SA        *      1.00       .00      9.00     29.50      3.00   42.50
             *
             *
             *
  AFFECTED   *               31.00     27.00     39.00             97.00
             *
             *
             *
*****************************************************************************
             *
   GROUND    *
   TOTALS    *    621.00     77.00     46.00     53.00      6.00  797.00
             *
```

```
                         TVA AIR POLLUTION STUDY  1970

                              INTERPRETER  WAH

                      800  SCALE    12  FILTER    IR COL FILM


INTERPRETED                                 ACTUAL
CONDITION                                 CONDITION

                  UA        TRACE       MA         SA     COMMITTED   PI
                                                                    TOTALS
******************************************************************************
             *
             *
  OMIT'D     *  595.00      55.00      20.00       7.00              677.00
             *
             *
  TRACE      *   21.50      16.00      11.00       1.00       4.00    53.50
             *
             *
  MA         *    3.50       6.00       9.00      12.75       3.00    34.25
             *
             *
  SA         *    1.00        .00       6.00      32.25      21.00    60.25
             *
             *
             *
 AFFECTED    *              22.00      26.00      46.00               94.00
             *
             *
             *
******************************************************************************
             *
 GROUND      *
 TOTALS      *  621.00      77.00      46.00      53.00      28.00   797.00
             *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER RC

800 SCALE 12 FILTER IR COL FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PT TOTALS
OMIT'D	598.00	56.00	25.00	13.00		692.00
TRACE	18.00	5.00	4.00	1.00	.00	28.00
MA	4.00	8.00	6.33	4.50	2.00	24.83
SA	1.00	8.00	10.67	34.50	5.00	59.17
AFFECTED		21.00	21.00	40.00		82.00
GROUND TOTALS	621.00	77.00	46.00	53.00	7.00	797.00

```
                         TVA AIR POLLUTION STUDY  1970

                              INTERPRETER  DLM

                      800  SCALE    12  FILTER    IR COL FILM


INTERPRETED                          ACTUAL
CONDITION                           CONDITION

                   UA      TRACE      MA        SA     COMMITTED   PI
                                                                  TOTALS
****************************************************************************
            *
            *
   OMIT'D   *    610.00    56.00     26.00      9.00             701.00
            *
            *
   TRACE    *      7.00    14.00      8.00      3.00      .00     32.00
            *
            *
   MA       *      4.00     5.00      7.00     14.50     1.00     31.50
            *
            *
   SA       *       .00     2.00      5.00     26.50     4.00     37.50
            *
            *
            *
  AFFECTED  *              21.00     20.00     44.00              85.00
            *
            *
            *
****************************************************************************
            *
  GROUND    *
  TOTALS    *    621.00    77.00     46.00     53.00     5.00    797.00
            *
```

```
                         TVA AIR POLLUTION STUDY  1970

                               INTERPRETER   BN

                       1584  SCALE     D  FILTER    COLOR  FILM


  INTERPRETED                             ACTUAL
  CONDITION                               CONDITION

                                                                     PI
                    UA       TRACE       MA         SA    COMMITTED  TOTALS

*************************************************************************
              *
              *
     OMIT'D   *  1061.00    207.00     57.00      42.00             1367.00
              *
              *
     TRACE    *    90.50     23.00      8.50       6.00       .00    128.00
              *
              *
     MA       *    41.00     21.00     13.50      18.00       .00     93.50
              *
              *
     SA       *     1.50      3.00      9.00      19.00       .00     32.50
              *
              *
              *
   AFFECTED   *              47.00     31.00      43.00              121.00
              *
              *
              *
*************************************************************************
              *
    GROUND    *
    TOTALS    *  1194.00    254.00     88.00      85.00       .00   1621.00
              *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER WAH

1584 SCALE D FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	1154.00	194.00	30.00	23.00		1401.00
TRACE	31.00	34.00	19.50	6.00	2.00	92.50
MA	7.00	25.00	25.50	18.00	5.00	80.50
SA	2.00	1.00	13.00	38.00	2.00	56.00
AFFECTED		60.00	58.00	62.00		180.00
GROUND TOTALS	1194.00	254.00	88.00	85.00	9.00	1621.00

TVA AIR POLLUTION STUDY 1970

INTERPRETER RC

1584 SCALE D FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	1164.00	197.00	42.00	34.00		1437.00
TRACE	27.50	47.50	25.00	4.50	1.00	105.50
MA	2.00	9.50	17.00	14.00	1.00	43.50
SA	.50	.00	4.00	32.50	1.00	38.00
AFFECTED		57.00	46.00	51.00		154.00
GROUND TOTALS	1194.00	254.00	88.00	85.00	3.00	1621.00

```
                     TVA AIR POLLUTION STUDY  1970

                           INTERPRETER  DLM

                 1584  SCALE     D  FILTER    COLOR  FILM


INTERPRETED                            ACTUAL
CONDITION                             CONDITION

                                                                  PI
                UA       TRACE       MA         SA      COMMITTED  TOTALS

*****************************************************************************
           *
           *
  OMIT'D   *  1168.00    217.00     52.00      28.00             1465.00
           *
           *
  TRACE    *    22.00     30.00     19.00      13.50        .00    84.50
           *
           *
  MA       *     4.00      5.00     14.00      16.00        .00    39.00
           *
           *
  SA       *      .00      2.00      3.00      27.50       1.00    33.50
           *
           *
           *
 AFFECTED  *               37.00     36.00      57.00             130.00
           *
           *
           *
*****************************************************************************
           *
 GROUND    *
 TOTALS    *  1194.00    254.00     88.00      85.00       1.00  1621.00
           *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER BN

1584 SCALE 12 FILTER IR COL FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	977.00	206.00	49.00	34.00		1266.00
TRACE	75.50	36.00	15.50	4.00	1.00	132.00
MA	4.00	10.00	14.50	19.00	.00	47.50
SA	.50	1.00	9.00	27.00	.00	37.50
AFFECTED		47.00	39.00	50.00		136.00
GROUND TOTALS	1057.00	253.00	83.00	84.00	1.00	1482.00

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                  TVA AIR POLLUTION STUDY  1970

                       INTERPRETER  WAH

              1584  SCALE    12  FILTER    IR COL FILM


INTERPRETED                          ACTUAL
CONDITION                           CONDITION

                                                               PI
                UA      TRACE       MA        SA    COMMITTED  TOTALS

************************************************************************
           *
           *
  OMIT'D   *   981.00    198.00     45.00     21.00             1245.00
           *
           *
  TRACE    *    31.00     24.50     13.00      6.00      4.00     78.50
           *
           *
  MA       *    30.00     26.50     19.00     15.50      3.00     94.00
           *
           *
  SA       *    15.00      4.00     11.00     41.50      6.00     77.50
           *
           *
           *
 AFFECTED  *               55.00     43.00     63.00             161.00
           *
           *
           *
************************************************************************
           *
 GROUND    *
 TOTALS    *  1057.00    253.00     88.00     84.00     13.00   1482.00
           *
```

```
                    TVA AIR POLLUTION STUDY  1970

                         INTERPRETER   RC

                 1584  SCALE    12  FILTER    IR COL FILM


INTERPRETED                         ACTUAL
CONDITION                          CONDITION

                                                                 PT
                UA      TRACE      MA        SA     COMMITTED  TOTALS

***********************************************************************
             *
             *
  OMIT'D     *    995.00    204.00     44.00     24.00             1267.00
             *
             *
  TRACE      *     54.00     34.00     20.50      8.50      1.00    118.00
             *
             *
  MA         *      8.00     14.00     17.50     22.00      2.00     63.50
             *
             *
  SA         *       .00      1.00      6.00     29.50       .00     36.50
             *
             *
             *
 AFFECTED    *               49.00     44.00     60.00              153.00
             *
             *
             *
***********************************************************************
             *
  GROUND     *
  TOTALS     *   1057.00    253.00     88.00     84.00      3.00   1482.00
             *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER DLM

1584 SCALE 12 FILTER IR COL FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	1028.00	219.00	51.00	26.00		1324.00
TRACE	28.00	31.00	30.00	19.00	.00	108.00
MA	.00	3.00	7.00	22.00	4.00	36.00
SA	1.00	.00	.00	17.00	.00	18.00
AFFECTED		34.00	37.00	58.00		129.00
GROUND TOTALS	1057.00	253.00	88.00	84.00	4.00	1482.00

```
                    TVA AIR POLLUTION STUDY  1970

                          INTERPRETER   BN

                 3960  SCALE  HF3&4 FILTER     COLOR FILM


 INTERPRETED                           ACTUAL
  CONDITION                           CONDITION

                                                                     PI
                 UA       TRACE       MA        SA      COMMITTED  TOTALS

*****************************************************************************
             *
             *
   OMIT'D    *  1150.00    238.00     79.00     76.00              1543.00
             *
             *
   TRACE     *    42.00     11.00      3.00      3.00      .00       59.00
             *
             *
   MA        *     1.00      4.00      6.00      3.00      .00       14.00
             *
             *
   SA        *     1.00      1.00       .00      3.00      .00        5.00
             *
             *
             *
  AFFECTED   *               16.00      9.00      9.00                34.00
             *
             *
             *
*****************************************************************************
             *
   GROUND    *
   TOTALS    *  1194.00    254.00     88.00     85.00      .00     1621.00
             *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER WAH

3960 SCALE HF3&4 FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	1171.00	236.00	72.00	50.00		1529.00
TRACE	17.00	15.00	4.00	6.00	.00	42.00
MA	6.00	3.00	11.00	14.00	.00	34.00
SA	.00	.00	1.00	15.00	.00	16.00
AFFECTED		18.00	16.00	35.00		69.00
GROUND TOTALS	1194.00	254.00	88.00	85.00	.00	1621.00

```
                    TVA AIR POLLUTION STUDY  1970

                          INTERPRETER   RC

                 3960  SCALE  HF3&4 FILTER     COLOR FILM


INTERPRETED                            ACTUAL
CONDITION                              CONDITION

                                                                  PI
                  UA       TRACE        MA         SA     COMMITTED  TOTALS

****************************************************************************
              *
              *
  OMIT'D      *  1175.00    226.00     62.00      43.00             1506.00
              *
              *
  TRACE       *    19.00     24.50     15.00       8.00        .00    66.50
              *
              *
  MA          *      .00      3.50      7.00      19.00        .00    29.50
              *
              *
  SA          *      .00       .00      4.00      15.00        .00    19.00
              *
              *
              *
 AFFECTED     *              28.00     26.00      42.00               96.00
              *
              *
              *
****************************************************************************
              *
  GROUND      *
  TOTALS      *  1194.00    254.00     88.00      85.00        .00  1621.00
              *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER DLM

3960 SCALE HF3&4 FILTER COLOR FILM

INTERPRETED CONDITION	ACTUAL CONDITION					
	UA	TRACE	MA	SA	COMMITTED	PI TOTALS
OMIT'D	1189.00	240.00	71.00	42.00		1542.00
TRACE	5.00	10.00	9.00	8.00	.00	32.00
MA	.00	3.00	6.00	23.00	.00	32.00
SA	.00	1.00	2.00	12.00	.00	15.00
AFFECTED		14.00	17.00	43.00		74.00
GROUND TOTALS	1194.00	254.00	88.00	85.00	.00	1621.00

```
                          TVA AIR POLLUTION STUDY  1970

                                INTERPRETER   BN

                     3960  SCALE    12  FILTER    IR COL FILM


 INTERPRETED                              ACTUAL
 CONDITION                               CONDITION

                                                                      PI
                   UA        TRACF       MA        SA     COMMITTED  TOTALS

*********************************************************************************
              *
              *
   OMIT'D     *  1151.00    228.00     68.00     51.00              1498.00
              *
              *
   TRACE      *    42.00     20.00     11.00     14.00       .00      87.00
              *
              *
   MA         *     1.00      4.00      3.00      7.00       .00      15.00
              *
              *
   SA         *      .00      2.00      6.00     13.00       .00      21.00
              *
              *
              *
  AFFECTED    *              26.00     20.00     34.00                80.00
              *
              *
              *
*********************************************************************************
              *
  GROUND      *
  TOTALS      *  1194.00    254.00     88.00     85.00       .00    1621.00
              *
```

```
                        TVA AIR POLLUTION STUDY  1970

                             INTERPRETER  WAH

                     3960  SCALE    12  FILTER    IR COL FILM


   INTERPRETED                        ACTUAL
   CONDITION                         CONDITION

                                                                         PI
                    UA       TRACE       MA        SA     COMMITTED  TOTALS

**************************************************************************
              *
              *
     OMIT'D   *  1160.00    230.00     71.00     40.00              1501.00
              *
              *
     TRACE    *    23.00     10.50      7.50     12.50       .00      53.50
              *
              *
     MA       *     7.00     11.50      6.00     10.50      1.00      36.00
              *
              *
     SA       *     4.00      2.00      3.50     22.00      2.00      33.50
              *
              *
              *
   AFFECTED   *              24.00     17.00     45.00                86.00
              *
              *
              *
**************************************************************************
              *
    GROUND    *
    TOTALS    *  1194.00    254.00     88.00     85.00      3.00    1621.00
              *
```

```
                      TVA AIR POLLUTION STUDY  1970

                            INTERPRETER   RC

                    3960  SCALE    12  FILTER    IR COL FILM


INTERPRETED                              ACTUAL
 CONDITION                              CONDITION
                                                                      PI
                   UA       TRACE       MA        SA     COMMITTED  TOTALS

*************************************************************************
                *
                *
   OMIT'D       *  1179.00   231.00    61.00     45.00              1516.00
                *
                *
   TRACE        *    11.00    13.00    11.00      3.00      .00       38.00
                *
                *
   MA           *     3.50     4.00    14.00     11.00      .00       32.50
                *
                *
   SA           *      .50     6.00     2.00     26.00      .00       34.50
                *
                *
                *
  AFFECTED      *             23.00    27.00     40.00                90.00
                *
                *
                *
*************************************************************************
                *
   GROUND       *
   TOTALS       *  1194.00   254.00    88.00     85.00      .00     1621.00
                *
```

```
                        TVA AIR POLLUTION STUDY  1970

                             INTERPRETER  DLM

                      3960  SCALE    12  FILTER    IR COL FILM


INTERPRETED                              ACTUAL
CONDITION                                CONDITION

                                                                        PI
                    UA       TRACE        MA          SA      COMMITTED  TOTALS

*************************************************************************************
             *
             *
  OMIT'D     *   1190.00     239.00      75.00       54.00               1558.00
             *
             *
  TRACE      *      3.00      12.00       8.00       11.00         .00     34.00
             *
             *
  MA         *      1.00       2.00       4.00       13.00         .00     20.00
             *
             *
  SA         *       .00       1.00       1.00        7.00         .00      9.00
             *
             *
             *
 AFFECTED    *                15.00      13.00       31.00                  59.00
             *
             *
             *
*************************************************************************************
             *
 GROUND      *
 TOTALS      *   1194.00     254.00      88.00       85.00         .00   1621.00
             *
```

```
                    TVA AIR POLLUTION STUDY  1970

                          INTERPRETER   RN

                  800  SCALE     D  FILTER    COLOR  FILM


 INTERPRETED                           ACTUAL
   SPECIES                             SPECIES

                                                                      PI
                   LP         VP         SP         HDW    COMMITTED  TOTALS

*********************************************************************************
               *
               *
     LP        *    41.00      3.00       .00       1.00      2.00     47.00
               *
               *
     VP        *     1.00     23.00       .00        .00      4.00     28.00
               *
               *
     SP        *     4.00       .00      5.00       1.00       .00     10.00
               *
               *
     HDW       *      .00      1.00       .00      30.00      3.00     34.00
               *
   AFFECTED    *
   & OMIT'D    *    22.00     20.00      1.00      23.00               66.00
               *
               *
*********************************************************************************
               *
    GROUND     *
    TOTAL      *    68.00     47.00      6.00      55.00              176.00
   AFFECTED    *
               *
    GROUND     *
    TOTALS     *   371.00     61.00    114.00     251.00      9.00    797.00
               *
```

```
                      TVA AIR POLLUTION STUDY  1970

                          INTERPRETER  WAH

                   800  SCALE     D  FILTER    COLOR  FILM


 INTERPRETED                              ACTUAL
   SPECIES                                SPECIES

                                                                      PI
                LP         VP         SP         HDW      COMMITTED  TOTALS

*****************************************************************************
             *
             *
    LP       *     43.00       1.33        .00        .00        .00      44.33
             *
             *
    VP       *      1.00      37.67        .00       2.00       9.00      49.67
             *
             *
    SP       *       .00        .00       4.00        .00       2.00       6.00
             *
             *
    HDW      *       .00       1.00        .00      20.00       8.00      29.00
             *
  AFFECTED   *
  & OMIT'D   *     24.00       7.00       2.00      33.00                 66.00
             *
             *
*****************************************************************************
             *
   GROUND    *
   TOTAL     *     68.00      47.00       6.00      55.00                176.00
  AFFECTED   *
             *
   GROUND    *
   TOTALS    *    371.00      61.00     114.00     251.00      19.00     797.00
             *
```

```
                            TVA AIR POLLUTION STUDY  1970

                                 INTERPRETER   RC

                        800  SCALE     D  FILTER    COLOR  FILM


INTERPRETED                                 ACTUAL
  SPECIES                                   SPECIES

                                                                           PI
                     LP          VP          SP          HDW    COMMITTED  TOTALS

****************************************************************************
               *
               *
     LP        *    21.00        .00         .00         .00        .00     21.00
               *
               *
     VP        *     2.00      36.50         .00         .00      11.00     49.50
               *
               *
     SP        *      .00        .00         .00         .00        .00       .00
               *
               *
     HDW       *      .00       2.50         .00       21.00       2.00     25.50
               *
  AFFECTED     *
  & OMIT'D     *    45.00       8.00        6.00       34.00                93.00
               *
               *
****************************************************************************
               *
   GROUND      *
   TOTAL       *    68.00      47.00        6.00       55.00               176.00
  AFFECTED     *
               *
   GROUND      *
   TOTALS      *   371.00      61.00      114.00      251.00      13.00    797.00
               *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER DLM

800 SCALE D FILTER COLOR FILM

INTERPRETED SPECIES	ACTUAL SPECIES					
	LP	VP	SP	HDW	COMMITTED	PT TOTALS
LP	33.75	.00	.00	.00	.00	33.75
VP	1.00	33.50	.00	.00	3.00	37.50
SP	9.25	1.00	1.00	.00	1.00	12.25
HDW	.00	.50	.00	10.00	3.00	13.50
AFFECTED & OMIT'D	24.00	12.00	5.00	45.00		86.00
GROUND TOTAL AFFECTED	68.00	47.00	6.00	55.00		176.00
GROUND TOTALS	371.00	61.00	114.00	251.00	7.00	797.00

```
                    TVA AIR POLLUTION STUDY  1970

                           INTERPRETER   RN

               800  SCALE    12  FILTER    IR COL FILM

INTERPRETED                         ACTUAL
  SPECIES                           SPECIES
                                                                PI
                  LP        VP        SP       HDW    COMMITTED TOTALS

*********************************************************************
              *
              *
    LP        *   41.00      2.50       .00       .00     1.00    44.50
              *
              *
    VP        *     .00     24.50       .00      2.00     2.00    28.50
              *
              *
    SP        *     .00       .00      1.00      2.00     1.00     4.00
              *
              *
    HDW       *    1.00      3.00       .00     20.00     2.00    26.00
              *
 AFFECTED     *
 & OMIT'D     *   26.00     17.00      5.00     31.00             79.00
              *
              *
*********************************************************************
              *
 GROUND       *
 TOTAL        *   68.00     47.00      6.00     55.00            176.00
 AFFECTED     *
              *
 GROUND       *
 TOTALS       *  371.00     61.00    114.00    251.00     6.00   797.00
              *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER WAH

800 SCALE 12 FILTER IR COL FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	42.00	1.50	.00	.00	1.00	44.50
VP	.00	33.50	.00	.00	13.00	46.50
SP	.00	.00	1.00	.00	1.00	2.00
HDW	.00	1.00	.00	15.00	13.00	29.00
AFFECTED & OMIT'D	26.00	11.00	5.00	40.00		82.00
GROUND TOTAL AFFECTED	68.00	47.00	6.00	55.00		176.00
GROUND TOTALS	371.00	61.00	114.00	251.00	28.00	797.00

```
                    TVA AIR POLLUTION STUDY  1970

                           INTERPRETER   RC

                 800  SCALE    12  FILTER    IR COL FILM


 INTERPRETED                          ACTUAL
   SPECIES                            SPECIES
                                                                PI
                 LP        VP        SP        HDW   COMMITTED  TOTALS

**********************************************************************
           *
           *
    LP     *    26.00      .00       .00       .00      1.00     27.00
           *
           *
    VP     *     2.00    34.00       .00      1.00      6.00     43.00
           *
           *
    SP     *      .00      .00      3.00       .00       .00      3.00
           *
           *
    HDW    *      .00      .00       .00     16.00       .00     16.00
           *
 AFFECTED  *
 & OMIT'D  *    40.00    13.00      3.00     38.00               94.00
           *
           *
**********************************************************************
           *
  GROUND   *
  TOTAL    *    68.00    47.00      6.00     55.00              176.00
 AFFECTED  *
           *
  GROUND   *
  TOTALS   *   371.00    61.00    114.00    251.00      7.00    797.00
           *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER DLM

800 SCALE 12 FILTER IR COL FILM

INTERPRETED SPECIES	ACTUAL SPECIES					
	LP	VP	SP	HDW	COMMITTED	PT TOTALS
LP	26.00	.00	.00	.00	.00	26.00
VP	.00	25.00	1.00	.00	3.00	29.00
SP	2.00	4.00	.00	.00	.00	6.00
HDW	1.00	8.00	.00	18.00	2.00	29.00
AFFECTED & OMIT'D	39.00	10.00	5.00	37.00		91.00
GROUND TOTAL AFFECTED	68.00	47.00	6.00	55.00		176.00
GROUND TOTALS	371.00	61.00	114.00	251.00	5.00	797.00

TVA AIR POLLUTION STUDY 1970

INTERPRETER RN

1584 SCALE D FILTER COLOR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	75.50	1.00	.00	.00	.00	76.50
VP	2.00	17.00	.00	.00	.00	19.00
SP	2.00	.00	5.00	2.00	.00	9.00
HDW	2.50	1.00	.00	13.00	.00	16.50
AFFECTED & OMIT'D	212.00	28.00	2.00	64.00		306.00
GROUND TOTAL AFFECTED	294.00	47.00	7.00	79.00		427.00
GROUND TOTALS	1000.00	61.00	141.00	419.00	.00	1621.00

```
                         TVA AIR POLLUTION STUDY  1970

                              INTERPRETER  WAH

                      1584  SCALE     D  FILTER    COLOR  FILM


INTERPRETED                             ACTUAL
  SPECIES                               SPECIES

                                                                    PI
                LP          VP          SP         HDW     COMMITTED  TOTALS

*****************************************************************************
              *
              *
    LP        *   117.00        1.00        1.00        1.00        2.00    122.00
              *
              *
    VP        *     2.00       27.00        2.00        1.00        2.00     34.00
              *
              *
    SP        *     1.00         .00        2.00         .00         .00      3.00
              *
              *
   HDW        *     1.00        1.00         .00       24.00        5.00     31.00
              *
 AFFECTED     *
 & OMIT'D     *   173.00       18.00        2.00       53.00                246.00
              *
              *
*****************************************************************************
              *
  GROUND      *
  TOTAL       *   294.00       47.00        7.00       79.00                427.00
 AFFECTED     *
              *
  GROUND      *
  TOTALS      *  1000.00       61.00      141.00      419.00        9.00   1621.00
              *
```

```
                     TVA AIR POLLUTION STUDY  1970

                           INTERPRETER   RC

                  1584  SCALE     D  FILTER    COLOR  FILM


INTERPRETED                            ACTUAL
  SPECIES                              SPECIES

                                                                   PT
                  LP        VP        SP        HDW    COMMITTED  TOTALS

*************************************************************************
            *
            *
   LP       *   122.00      2.00       .00      3.00      2.00   129.00
            *
            *
   VP       *     1.00     13.00      1.00       .00      1.00    16.00
            *
            *
   SP       *      .00       .00       .00       .00       .00      .00
            *
            *
   HDW      *     1.00      2.00      1.00      9.00       .00    13.00
            *
 AFFECTED   *
 & OMIT'D   *   170.00     30.00      5.00     67.00             272.00
            *
            *
*************************************************************************
            *
  GROUND    *
  TOTAL     *   294.00     47.00      7.00     79.00             427.00
 AFFECTED   *
            *
  GROUND    *
  TOTALS    *  1000.00     61.00    141.00    419.00      3.00  1621.00
            *
```

```
                    TVA AIR POLLUTION STUDY  1970

                          INTERPRETER  DLM

                 1584  SCALE     D  FILTER    COLOR  FILM


INTERPRETED                          ACTUAL
  SPECIES                            SPECIES

                   LP        VP        SP        HDW     COMMITTED   PT
                                                                   TOTALS
*************************************************************************
             *
             *
    LP       *    78.00      1.00       .00      1.00       .00     80.00
             *
             *
    VP       *      .00     14.00       .00      1.00       .00     15.00
             *
             *
    SP       *    14.00      5.50       .00      1.00      1.00     21.50
             *
             *
    HDW      *      .00      2.50      2.00     10.00       .00     14.50
             *
 AFFECTED    *
 & OMIT'D    *   202.00     24.00      5.00     66.00              297.00
             *
             *
*************************************************************************
             *
  GROUND     *
  TOTAL      *   294.00     47.00      7.00     79.00              427.00
 AFFECTED    *
             *
  GROUND     *
  TOTALS     *  1000.00     61.00    141.00    419.00      1.00   1621.00
             *
```

```
                       TVA AIR POLLUTION STUDY  1970

                            INTERPRETER   RN

                   1584  SCALE    12  FILTER    IR COL FILM


 INTERPRETED                          ACTUAL
  SPECIES                             SPECIES

                                                                       PI
                   LP         VP         SP        HDW     COMMITTED  TOTALS

***************************************************************************
               *
               *
    LP         *  87.00       2.00        .00       2.00        .00     91.00
               *
               *
    VP         *   3.00      20.00        .00       1.00        .00     24.00
               *
               *
    SP         *    .00        .00       1.00        .00        .00      1.00
               *
               *
    HDW        *   8.00        .00        .00      12.00       1.00     21.00
               *
  AFFECTED     *
  & OMIT'D     * 196.00      25.00       5.00      63.00               289.00
               *
               *
***************************************************************************
               *
   GROUND      *
   TOTAL       * 294.00      47.00       6.00      78.00               425.00
  AFFECTED     *
               *
   GROUND      *
   TOTALS      *1000.00      61.00     125.00     296.00       1.00   1482.00
               *
```

```
                    TVA AIR POLLUTION STUDY  1970

                         INTERPRETER  WAH

                   1584  SCALE    12  FILTER    IR COL FILM

 INTERPRETED                         ACTUAL
  SPECIES                            SPECIES

                                                                PI
                  LP        VP        SP        HDW   COMMITTED  TOTALS

*************************************************************************
             *
             *
    LP       *   90.00       .00       .00       .00      3.00     93.00
             *
             *
    VP       *    2.00     28.00       .00       .00      4.00     34.00
             *
             *
    SP       *    2.00       .00      5.00      1.00       .00      8.00
             *
             *
    HDW      *    3.00       .00       .00     31.00      6.00     40.00
             *
 AFFECTED    *
 & OMIT'D    *  197.00     19.00      1.00     46.00              263.00
             *
             *
*************************************************************************
             *
  GROUND     *
  TOTAL      *  294.00     47.00      6.00     78.00              425.00
 AFFECTED    *
             *
  GROUND     *
  TOTALS     * 1000.00     61.00    125.00    296.00     13.00   1482.00
             *
```

```
                         TVA AIR POLLUTION STUDY  1970

                               INTERPRETER   RC

                      1584  SCALE     12  FILTER    IR COL FILM


 INTERPRETED                              ACTUAL
   SPECIES                                SPECIES

                                                                         PI
                  LP         VP         SP         HDW     COMMITTED  TOTALS

**************************************************************************
             *
             *
    LP       *  104.00       2.50        .00        .00       3.00    109.50
             *
             *
    VP       *   13.00      20.50        .00        .00        .00     33.50
             *
             *
    SP       *     .00        .00       5.00        .00        .00      5.00
             *
             *
    HDW      *    1.00       1.00        .00       6.00        .00      8.00
             *
  AFFECTED   *
  & OMIT'D   *  176.00      23.00       1.00      72.00               272.00
             *
             *
**************************************************************************
             *
  GROUND     *
  TOTAL      *  294.00      47.00       6.00      78.00               425.00
  AFFECTED   *
             *
  GROUND     *
  TOTALS     * 1000.00      61.00     125.00     296.00       3.00   1482.00
             *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER DLM

1584 SCALE 12 FILTER IR COL FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	73.00	4.00	.00	1.00	4.00	82.00
VP	1.00	5.00	1.00	.00	.00	7.00
SP	8.00	15.00	.00	.00	.00	23.00
HDW	4.00	2.00	.00	16.00	.00	22.00
AFFECTED & OMIT'D	208.00	21.00	5.00	61.00		295.00
GROUND TOTAL AFFECTED	294.00	47.00	6.00	78.00		425.00
GROUND TOTALS	1000.00	61.00	125.00	296.00	4.00	1482.00

```
                     TVA AIR POLLUTION STUDY  1970

                           INTERPRETER   3N

                 3960  SCALE  HF3&4 FILTER     COLOR FILM


INTERPRETED                            ACTUAL
  SPECIES                              SPECIES

                                                                     PI
                   LP        VP        SP        HDW     COMMITTED  TOTALS

*******************************************************************************
            *
            *
   LP       *    17.00       .00       .00       .00       .00      17.00
            *
            *
   VP       *      .00      5.00       .00       .00       .00       5.00
            *
            *
   SP       *     4.00       .00      3.00       .00       .00       7.00
            *
            *
   HDW      *      .00      1.00      2.00      2.00       .00       5.00
            *
 AFFECTED   *
 & OMIT'D   *   273.00     41.00      2.00     77.00               393.00
            *
            *
*******************************************************************************
            *
  GROUND    *
  TOTAL     *   294.00     47.00      7.00     79.00               427.00
 AFFECTED   *
            *
  GROUND    *
  TOTALS    *  1000.00     61.00    141.00    419.00       .00    1621.00
            *
```

```
                        TVA AIR POLLUTION STUDY  1970

                              INTERPRETER  WAH

                    3960  SCALE  HF3&4 FILTER     COLOR FILM


 INTERPRETED                             ACTUAL
   SPECIES                               SPECIES

                                                                      PI
                     LP         VP         SP         HDW   COMMITTED  TOTALS

*************************************************************************
             *
             *
    LP       *     49.00       1.00        .00       2.00        .00     52.00
             *
             *
    VP       *      1.00       7.00        .00        .00        .00      8.00
             *
             *
    SP       *       .00        .00        .00        .00        .00       .00
             *
             *
    HDW      *      5.00       3.00       1.00        .00        .00      9.00
             *
  AFFECTED   *
  & OMIT'D   *    239.00      36.00       6.00      77.00               358.00
             *
             *
*************************************************************************
             *
   GROUND    *
   TOTAL     *    294.00      47.00       7.00      79.00               427.00
  AFFECTED   *
             *
   GROUND    *
   TOTALS    *   1000.00      61.00     141.00     419.00        .00   1621.00
             *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER RC

3960 SCALE HF3&4 FILTER COLOR FILM

INTERPRETED SPECIES	ACTUAL SPECIES LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	72.00	.50	.00	.00	.00	72.50
VP	3.00	11.50	.00	1.00	.00	15.50
SP	.00	.00	.00	.00	.00	.00
HDW	1.00	1.00	1.00	5.00	.00	8.00
AFFECTED & OMIT'D	218.00	34.00	6.00	73.00		331.00
GROUND TOTAL AFFECTED	294.00	47.00	7.00	79.00		427.00
GROUND TOTALS	1000.00	61.00	141.00	419.00	.00	1621.00

```
                         TVA AIR POLLUTION STUDY  1970

                               INTERPRETER  DLM

                     3960  SCALE  HF3&4 FILTER     COLOR FILM

INTERPRETED
  SPECIES                                 ACTUAL
                                          SPECIES

                    LP         VP         SP         HDW     COMMITTED    PT
                                                                        TOTALS
************************************************************************************
              *
              *
    LP        *    53.00       1.00       .00       2.00       .00      56.00
              *
              *
    VP        *      .00       6.00       .00        .00       .00       6.00
              *
              *
    SP        *     5.00       7.00       .00        .00       .00      12.00
              *
              *
    HDW       *      .00        .00       .00        .00       .00        .00
              *
 AFFECTED     *
 & OMIT'D     *   236.00      33.00      7.00      77.00                353.00
              *
              *
************************************************************************************
              *
  GROUND      *
  TOTAL       *   294.00      47.00      7.00      79.00                427.00
 AFFECTED     *
              *
  GROUND      *
  TOTALS      *  1000.00      61.00    141.00     419.00       .00     1621.00
              *
```

```
                     TVA AIR POLLUTION STUDY  1970

                           INTERPRETER   RN

               3960  SCALE    12  FILTER    IR COL FILM


INTERPRETED                         ACTUAL
  SPECIES                           SPECIES
                                                                 PI
                  LP        VP        SP        HDW   COMMITTED  TOTALS

*************************************************************************
               *
               *
     LP        *    60.00      2.00       .00      3.00       .00     65.00
               *
               *
     VP        *      .00      7.00       .00       .00       .00      7.00
               *
               *
     SP        *     2.00       .00      2.00       .00       .00      4.00
               *
               *
     HDW       *     1.00       .00      2.00      1.00       .00      4.00
               *
   AFFECTED    *
   & OMIT'D    *   231.00     38.00      3.00     75.00               347.00
               *
               *
*************************************************************************
               *
   GROUND      *
   TOTAL       *   294.00     47.00      7.00     79.00               427.00
   AFFECTED    *
               *
   GROUND      *
   TOTALS      *  1000.00     61.00    141.00    419.00       .00   1621.00
               *
```

TVA AIR POLLUTION STUDY 1970

INTERPRETER WAH

3960 SCALE 12 FILTER IR COL FILM

INTERPRETED SPECIES	ACTUAL SPECIES					
	LP	VP	SP	HDW	COMMITTED	PI TOTALS
LP	51.50	.50	.00	.00	.00	52.00
VP	2.50	19.50	.00	1.50	2.00	25.50
SP	.00	.00	.00	.00	.00	.00
HDW	.00	.00	.00	10.50	1.00	11.50
AFFECTED & OMIT'D	240.00	27.00	7.00	67.00		341.00
GROUND TOTAL AFFECTED	294.00	47.00	7.00	79.00		427.00
GROUND TOTALS	1000.00	61.00	141.00	419.00	3.00	1621.00

```
                    TVA AIR POLLUTION STUDY  1970

                          INTERPRETER   RC

                3960  SCALE     12  FILTER     IR COL FILM


INTERPRETED                        ACTUAL
  SPECIES                          SPECIES

                                                                 PI
                 LP        VP        SP        HDW   COMMITTED  TOTALS

*******************************************************************
               *
               *
    LP         *    64.00      2.00       .00       .00       .00     66.00
               *
               *
    VP         *     4.00     11.00       .00      1.00       .00     16.00
               *
               *
    SP         *      .00       .00      1.00       .00       .00      1.00
               *
               *
    HDW        *     1.00      2.00       .00      4.00       .00      7.00
               *
  AFFECTED     *
  & OMIT'D     *   225.00     32.00      6.00     74.00               337.00
               *
               *
*******************************************************************
               *
   GROUND      *
   TOTAL       *   294.00     47.00      7.00     79.00               427.00
  AFFECTED     *
               *
   GROUND      *
   TOTALS      *  1000.00     61.00    141.00    419.00       .00   1621.00
               *
```

```
                        TVA AIR POLLUTION STUDY  1970

                             INTERPRETER  DLM

                     3960  SCALE    12  FILTER    IR COL FILM


INTERPRETED                         ACTUAL
  SPECIES                           SPECIES
                                                                 PI
                 LP        VP        SP        HDW     COMMITTED TOTALS

**************************************************************************
            *
            *
    LP      *   44.00      5.00       .00       .00       .00     49.00
            *
            *
    VP      *     .00       .00       .00       .00       .00       .00
            *
            *
    SP      *     .00      3.00       .00       .00       .00      3.00
            *
            *
    HDW     *    2.00       .00       .00      5.00       .00      7.00
            *
  AFFECTED  *
  & OMIT'D  *  248.00     39.00      7.00     74.00              368.00
            *
            *
**************************************************************************
            *
   GROUND   *
   TOTAL    *  294.00     47.00      7.00     79.00              427.00
  AFFECTED  *
            *
   GROUND   *
   TOTALS   * 1000.00     61.00    141.00    419.00       .00   1621.00
            *
```

```
                         TVA AIR POLLUTION STUDY  1969

                         SPECIES HDW      AFFECTED TREES



         CRCL  DBH  HUE  VAL CHRO COND  LEN DNOT DNLN CAST  LEN DNOT DNLN CAST SHGR

       ****************************************************************************
       *
CRCL   * 1.00
       *
DBH    * -.39 1.00
       *
HUE    *  .12  .11 1.00
       *
VAL    * -.15  .13 -.40 1.00
       *
CHRO   * -.25  .25 -.17  .53 1.00
       *
COND   *  .05 -.07 -.05  .20 -.19 1.00
       *
LEN    *  .00  .00  .00  .00  .00  .00  .00
       *
DNOT   *  .00  .00  .00  .00  .00  .00  .00  .00
       *
DNLN   *  .00  .00  .00  .00  .00  .00  .00  .00  .00
       *
CAST   *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
       *
LEN    *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
       *
DNOT   *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
       *
DNLN   *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
       *
CAST   *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
       *
SHGR   *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
```

n ranges from 49-54

AFFECTED TREES - 1969

```
          CRCL  DBH  HUE  VAL CHRO COND  LEN DNOT DNLN CAST  LEN DNOT DNLN CAST SHGR
       ****************************************************************************
       *
 CRCL  * 1.00
       *
  DBH  * -.52 1.00
       *
  HUE  *  .04  .06 1.00
       *
  VAL  * -.01 -.06 -.35 1.00
       *
 CHRO  * -.01 -.09 -.05  .44 1.00
       *
 COND  *  .05  .01  .11  .07 -.05 1.00
       *
  LEN  * -.14  .08 -.10  .12 -.06  .00 1.00
       *
 DNOT  *  .07 -.08 -.33  .03  .07 -.57  .10 1.00
       *
 DNLN  *  .07 -.04 -.38  .02 -.05 -.50  .14  .68 1.00
       *
 CAST  * -.07  .01 -.17  .20  .06  .00  .58  .14  .10 1.00
       *
  LEN  *  .21 -.20 -.28  .03 -.05 -.13  .33  .21  .24  .28 1.00
       *
 DNOT  * -.08 -.03 -.10  .18  .07  .08  .07 -.14 -.27  .17  .19 1.00
       *
 DNLN  * -.10  .04 -.04  .06 -.05  .16  .06 -.21 -.30  .13  .07  .80 1.00
       *
 CAST  * -.03  .01 -.27  .15  .04 -.07  .53  .31  .26  .52  .58  .26  .13 1.00
       *
 SHGR  *  .18 -.19 -.22  .07 -.05 -.08  .40  .31  .24  .34  .64  .14  .09  .69 1.00
```

n ranges from 133-243

NOT REPRODUCIBLE

NOT REPRODUCIBLE

```
                    TVA AIR POLLUTION STUDY  1969

                    SPECIES PINE    UNAFFECTED TREES


       CRCL  DBH  HUE  VAL CHRO COND  LEN DNOT DNLN CAST  LEN DNOT DNLN CAST SHGR
     *****************************************************************************
     *
CRCL * 1.00
     *
 DBH * -.31 1.00
     *
 HUE * -.21  .25 1.00                          n ranges from 117-695
     *
 VAL * -.14 -.07  .04 1.00
     *
CHRO *  .21 -.17 -.20 -.19 1.00
     *
COND *  .00  .00  .00  .00  .00  .00
     *
 LEN *  .00  .05 -.08  .00  .07  .00 1.00
     *
DNOT *  .00  .00  .00  .00  .00  .00  .00  .00
     *
DNLN *  .00  .00  .00  .00  .00  .00  .00  .00  .00
     *
CAST *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
     *
 LEN * -.02  .01 -.17  .24  .12  .00  .48  .00  .00  .00 1.00
     *
DNOT *  .09 -.03  .02  .01  .12  .00  .00  .00  .00  .00  .02 1.00
     *
DNLN *  .10 -.04  .03  .01  .12  .00  .00  .00  .00  .00  .03  .86 1.00
     *
CAST *  .04 -.05 -.03  .03  .07  .00  .13  .00  .00  .00  .40  .12  .15 1.00
     *
SHGR *  .19 -.17 -.28 -.09  .13  .00  .11  .00  .00  .00  .48  .09  .05  .17 1.00
```

```
                    TVA AIR POLLUTION STUDY  1969

                    SPECIES HDW     UNAFFECTED TREES



       CRCL  DBH  HUE  VAL CHRO COND  LEN DNOT DNLN CAST  LEN DNOT DNLN CAST SHGR

      ******************************************************************************
      *
CRCL  * 1.00
      *
 DBH  * -.59 1.00
      *
 HUE  * -.01  .00 1.00
      *
 VAL  * -.16  .19 -.34 1.00
      *
CHRO  * -.16  .13 -.21  .71 1.00
      *
COND  *  .00  .00  .00  .00  .00  .00
      *
 LEN  *  .00  .00  .00  .00  .00  .00  .00
      *
DNOT  *  .00  .00  .00  .00  .00  .00  .00  .00
      *
DNLN  *  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
CAST  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
 LEN  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
DNOT  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
DNLN  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
CAST  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
SHGR  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
```

n ranges from 329-345

NOT REPRODUCIBLE

UNAFFECTED TREES - 1969

n ranges from 118-1040

```
        CRCL  DBH  HUE   VAL CHRO COND  LEN DNOT DNLN CAST  LEN DNOT DNLN CAST SHGR

      ****************************************************************************
      *
CRCL  * 1.00
      *
 DBH  * -.48 1.00
      *
 HUE  * -.16  .18 1.00
      *
 VAL  * -.14  .07 -.18 1.00
      *
CHRO  *  .18 -.20 -.24  .32 1.00
      *
COND  *  .00  .00  .00  .00  .00  .00
      *
 LEN  *  .00  .05 -.08  .00  .07  .00 1.00
      *
DNOT  *  .00  .00  .00  .00  .00  .00  .00  .00
      *
DNLN  *  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
CAST  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
 LEN  * -.02  .02 -.17  .24  .12  .00  .48  .00  .00  .00 1.00
      *
DNOT  *  .09 -.03  .02  .01  .12  .00  .00  .00  .00  .00  .03 1.00
      *
DNLN  *  .10 -.04  .03  .01  .12  .00  .00  .00  .00  .00  .03  .86 1.00
      *
CAST  *  .04 -.05 -.03  .03  .07  .00  .13  .00  .00  .00  .40  .12  .15 1.00
      *
SHGR  *  .19 -.17 -.28 -.09  .13  .00  .11  .00  .00  .00  .48  .09  .05  .17 1.00
```

NOT REPRODUCIBLE

```
                               TVA AIR POLLUTION STUDY  1970

                               SPECIES HDW      AFFECTED TREES

        COND CPCL APXC  HUF  VAL CHRO CAST  LEN DNOT DNLN APXC CAST  LEN DNOT DNLN APXC SHGR CONE CNLT

      ***************************************************************************************************
      *
COND  * 1.00
      *
CPCL  *  .06 1.00
      *
APXC  *  .43  .20 1.00
      *
 HUF  * -.31 -.13 -.67 1.00
      *
 VAL  *  .12  .03  .20 -.13 1.00
      *
CHRO  *  .36  .32  .37 -.24  .43 1.00
      *
CAST  *  .00  .00  .00  .00  .00  .00  .00
      *
 LEN  *  .00  .00  .00  .00  .00  .00  .00  .00
      *
DNOT  *  .57  .20  .38 -.37  .16  .30  .00  .00 1.00
      *
DNLN  *  .50  .29  .41 -.37  .22  .24  .00  .00  .31 1.00
      *
APXC  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
CAST  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
 LEN  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
DNOT  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
DNLN  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
APXC  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
SHGR  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
CONE  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
      *
CNLT  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
```

n ranges from 22-79

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1970

AFFECTED TREES

n ranges from 119-427

	COND	CRCL	APXC	HUE	VAL	CHRO	CAST	LEN	DNOT	DNLN	APXC	CAST	LEN	DNOT	DNLN	APXC	SHGR	CONE	CNLT
COND	1.00																		
CRCL	.18	1.00																	
APXC	.90	.19	1.00																
HUE	-.67	-.18	-.75	1.00															
VAL	-.02	-.15	.01	.25	1.00														
CHRO	.55	.11	.60	-.62	.19	1.00													
CAST	.11	-.04	.12	-.02	.16	.08	1.00												
LEN	.55	.44	.56	-.42	.04	.47	.09	1.00											
DNOT	.87	.19	.83	-.68	-.09	.50	-.03	.51	1.00										
DNLN	.79	.24	.82	-.73	-.08	.52	-.02	.50	.79	1.00									
APXC	.91	.25	.95	-.71	-.07	.59	.12	.60	.87	.82	1.00								
CAST	.57	.25	.58	-.44	-.03	.37	.17	.54	.55	.48	.57	1.00							
LEN	.41	.32	.40	-.29	.07	.27	.12	.65	.39	.40	.44	.48	1.00						
DNOT	.50	.09	.51	-.42	-.09	.26	.06	.32	.48	.47	.50	.43	.36	1.00					
DNLN	.39	.08	.46	-.33	-.06	.26	.09	.29	.40	.37	.45	.43	.34	.72	1.00				
APXC	.63	.05	.65	-.44	.09	.42	.16	.43	.62	.57	.66	.57	.49	.76	.66	1.00			
SHGR	.56	.36	.55	-.31	.11	.41	.19	.69	.48	.44	.55	.61	.58	.35	.35	.50	1.00		
CONE	.13	-.05	.03	.06	.13	-.04	-.01	.07	.04	.08	.06	.01	.17	.08	.06	.13	-.02	1.00	
CNLT	.05	-.13	-.02	.04	.21	.06	-.01	.11	.06	.02	.06	.05	.11	.02	-.01	.04	.01	.35	1.00

NOT REPRODUCIBLE

TVA AIR POLLUTION STUDY 1970

SPECIES PINE · UNAFFECTED TREES

```
        COND CPCL APXC  HUE  VAL CHRO CAST  LEN DNOT DNLN APXC CAST  LEN DNOT DNLN APXC SHGR CONE CNLT
     ********************************************************************************************************
     *
COND *   .00
     *
CPCL *   .00 1.00 .
     *
APXC *   .00  .07 1.00
     *
 HUE *   .00 -.05 -.66 1.00
     *
 VAL *   .00  .01  .14 -.16 1.00
     *
CHRO *   .00  .09  .45 -.42  .17 1.00
     *
CAST *   .00  .01 -.00  .00  .02 -.01 1.00
     *
 LEN *   .00  .25  .29 -.23  .01  .11  .00 1.00
     *
DNOT *   .00  .00  .00  .00  .00  .00  .00  .00  .00
     *
DNLN *   .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
     *
APXC *   .00  .09  .93 -.63  .14  .42  .00  .27  .00  .00 1.00
     *
CAST *   .00  .11  .48 -.36  .13  .31  .00  .27  .00  .00  .52 1.00
     *
 LEN *   .00  .16  .11 -.10  .01  .02  .00  .44  .00  .00  .12  .10 1.00
     *
DNOT *   .00  .04 -.01  .01  .01  .04  .00  .03  .00  .00 -.01  .34 -.01 1.00
     *
DNLN *   .00  .03 -.01  .01 -.00  .03  .00  .03  .00  .00 -.01  .29 -.01  .84 1.00
     *
APXC *   .00  .06  .54 -.33  .10  .29  .00  .09  .00  .00  .60  .30  .06  .51  .39 1.00
     *
SHGR *   .00  .34  .28 -.27  .09  .21  .00  .47  .00  .00  .31  .28  .44 -.03 -.03  .15 1.00
     *
CONE *   .00  .01 -.01  .02 -.05 -.02  .00  .17  .00  .00 -.01  .23 -.02 -.01  .13 -.02 -.02 1.00
     *
CNLT *   .00 -.01 -.01  .02 -.04 -.02  .00  .15  .00  .00 -.01  .25 -.02 -.02 -.02 -.02  .00  .61 1.00
```

n ranges from 677-854

NOT REPRODUCIBLE

```
                          TVA AIR POLLUTION STUDY  1976

                          SPECIES HOW      UNAFFECTED TREES

      COND CRCL APXC  HUE  VAL CHRO CAST  LEN DNOT DNLN APXC CAST  LEN DNOT DNLN APXC SHGR CONE CNLT

    ************************************************************************************************
    *
COND  *  .00
    *
CRCL  *  .00 1.00  .
    *
APXC  *  .00  .04 1.00                                  n ranges from 22-340
    *
 HUE  *  .00  .00  .00  .00
    *
 VAL  *  .00 -.13  .03  .00 1.00
    *
CHRO  *  .00  .02  .12  .00  .21 1.00
    *
CAST  *  .00  .00  .00  .00  .00  .00  .00
    *
 LEN  *  .00  .00  .00  .00  .00  .00  .00  .00
    *
DNOT  *  .00 -.06 -.02  .00  .01 -.03  .00  .00 1.00
    *
DNLN  *  .00 -.13 -.02  .00  .04  .02  .00  .00  .63 1.00
    *
APXC  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
    *
CAST  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
    *
 LEN  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
    *
DNOT  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
    *
DNLN  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
    *
APXC  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
    *
SHGR  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
    *
CONE  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
    *
CNLT  *  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00  .00
```

NOT REPRODUCIBLE

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                                   TVA AIR POLLUTION STUDY  1970

                                          UNAFFECTED TREES

          COND CRCL APXC  HUE  VAL CHRO CAST  LEN DNOT DNLN APXC CAST  LEN DNOT DNLN APXC SHGP CONE CNLT

       ************************************************************************************************
       *
 COND  *   .00
       *
 CRCL  *   .00 1.00
       *
 APXC  *   .00  .05 1.00
       *
  HUE  *   .00 -.02 -.62 1.00
       *
  VAL  *   .00  .01  .12 -.14 1.00
       *
 CHRO  *   .00  .15  .30 -.26  .19 1.00
       *
 CAST  *   .00  .00 -.00  .00  .02 -.01 1.00
       *
  LEN  *   .00  .25  .29 -.23  .01  .11  .00 1.00
       *
 DNOT  *   .00  .05 -.01  .02  .03  .03 -.00 -.01 1.00
       *
 DNLN  *   .00  .04 -.02  .02  .05  .08 -.01 -.01  .66 1.00
       *
 APXC  *   .00  .09  .93 -.63  .14  .42  .00  .27  .00  .00 1.00
       *
 CAST  *   .00  .11  .48 -.36  .13  .31  .00  .27  .00  .00  .52 1.00
       *
  LEN  *   .00  .16  .11 -.10  .01  .02  .00  .44  .00  .00  .12  .10 1.00
       *
 DNOT  *   .00  .04 -.01  .01  .01  .04  .00  .03  .00  .00 -.01  .34 -.01 1.00
       *
 DNLN  *   .00  .03 -.01  .01 -.00  .03  .00  .03  .00  .00 -.01  .29 -.01  .84 1.00
       *
 APXC  *   .00  .06  .54 -.33  .10  .29  .00  .09  .00  .00  .60  .30  .06  .51  .39 1.00
       *
 SHGP  *   .00  .33  .29 -.27  .09  .22  .00  .47 -.04 -.04  .31  .28  .44 -.03 -.03  .15 1.00
       *
 CONE  *   .00  .01 -.01  .02 -.05 -.02  .00  .17  .00  .00 -.01  .23 -.02 -.01  .13 -.02 -.02 1.00
       *
 CNLT  *   .00 -.01 -.01  .02 -.04 -.02  .00  .15  .00  .00 -.01  .25 -.02 -.02 -.02 -.02  .00  .61 1.00
```

n ranges from 679-1194

NOT REPRODUCIBLE